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## **Adoption, adaptation, stabilization and stagnation: software appropriation over time**

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### **Abstract**

*Persistent use of an information technology is necessary if it is to enhance productivity and user satisfaction. In this paper, we examine the process of appropriation of an application software over time, to gain a deeper understanding of the influences that encourage productive and persistent use. In a longitudinal study in an educational setting, through intensive field research, we identify changing expectations and influences that encourage persistent use of a technology above and beyond adoption. We identify further appropriation beyond initial stabilization and suggest that easy access to ongoing training is a driving force in avoiding stagnation and encouraging productive use.*

### **Keywords**

Technology appropriation, adoption, adaptation, stabilization, training

### **INTRODUCTION**

The aim of introducing a new technology, from an organization perspective, is to achieve productive use. This requires effective long term use, persisting well after the initial adoption of the technology. While there is much literature about the influences that affect adoption and acceptance of a technology (Brown, Massey, Montoya-Weiss and Burkman 2002; Davis 1989; Karahanna, Straub and Chervany 1999; Rogers 1995; Taylor and Todd 1995; Venkatesh, Morris, Davis and Davis 2003) and about how users adapt a technology to suit their needs (Ciborra 1996; DeSanctis and Poole 1994; Leonard-Barton 1988; Majchrzak, Rice, Malhotra and King 2000; Trigg and Bodker 1994; Tyre and Orlikowski 1994), little is known about the influences that encourage long term use. This lack of knowledge suggests the need for intensive research on the process of adoption through to long term use of different technologies in different environments.

This paper investigates the processes of appropriation of a technology over time in an educational setting. We define technology appropriation as: "*the way that users evaluate and adopt, adapt and integrate a technology into their everyday practices*" (Carroll, Howard, Peck and Murphy 2002). User experiences are observed at a number of points and the findings are analysed and interpreted using the Model of Technology Appropriation (Carroll et al. 2002). Our study identifies influences that affect adoption and encourage persistent use of an application software in an educational setting.

The underlying questions addressed in this paper are: *How do users in an educational environment appropriate a technology over a period of time? What influences the process of appropriation with time?*

We begin with the theories relating to the process of technology adoption and use, followed by the research methodology. The research findings are presented and their implications are discussed. The paper concludes by presenting some avenues for future research.

### **THEORETICAL BACKGROUND**

Technology usage and acceptance has long been an important topic for information systems researchers (Brown et al. 2002; Davis 1989; Davis, Bagozzi and Warshaw 1989; Moore and Benbasat 1991; Thompson, Higgins and Howell 1991; Taylor and Todd 1995; Venkatesh and Davis 2000). The Technology Acceptance Model (TAM)

has been one of the most prominent models to predict technology adoption and use. According to this model, adoption and usage of a technology are predicted by intentions to use the technology, which, in turn are influenced by perceptions and attitudes about the technology. Perceived usefulness and perceived ease of use are the main determinants of user acceptance (Davis 1989), according to TAM. Recent studies have revised TAM (Venkatesh et al. 2000; Venkatesh et al. 2003) by including social influences and key moderators. However, one shortcoming of TAM is that user's perceptions are different before adoption and after adoption (Carroll et al. 2003; Karahanna et al. 1999). Therefore, it is necessary to study the process from adoption to long term use.

Another theoretical approach to technology use builds on the Diffusion of Innovation Theory. According to this theory, the innovation decision process takes place in sequential stages. It starts from a user gaining knowledge about the innovation, to forming an attitude towards it, to deciding to adopt or reject the innovation, to implementing the new idea and finally to confirming the decision (Rogers 1995). According to this theory, perceived attributes of the innovation, number of adopters, type of innovation-decision, the communication channel and some social influences determine the rate of adoption. The major attributes that influence adoption according to the Diffusion of Innovation Theory are relative advantage, compatibility, complexity, trialability and observability. However, this theory emphasises more on the adoption of an innovation rather than the process of appropriation as users adapt and re-invent the technology to suit their needs in the long term. It is therefore necessary to better understand how and why users adopt and then use a technology over time.

Studying the process of long term use provides a deeper understanding of how and why users modify a technology to suit their needs. Some studies have focused on adaptation as a process of appropriation. Tyre and Orlikowski 1994 argue that most adaptation takes place following initial implementation - a window of opportunity. The technology stabilizes and the window of opportunity may then close. However, little is known about the changing influences that encourage or discourage the process of appropriation of a wide range of technologies used by different cohort of users.

Carroll et al. in 2002 conducted field research on mobile technologies and developed a Model of Technology Appropriation (MTA). According to the MTA, a technology that is introduced into a work place (technology as designed) is changed over time. The technology shapes the users' practice and in turn, is shaped by users' needs. This changed technology (technology in use) is an outcome of the process of appropriation which involves users trialling, evaluating and adapting the technology to suit their personal needs based on their perceptions and various other influences. The model represents three levels of evaluation of an ICT, with influences affecting these levels, as shown in Figure 1:

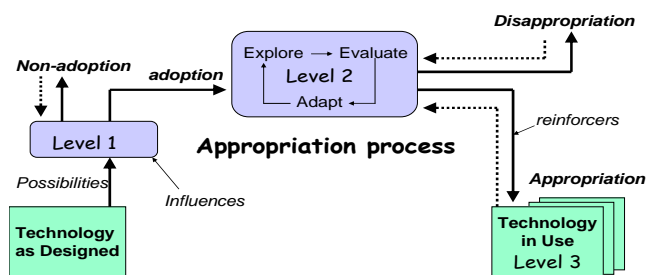


Figure 1: The Model of Technology Appropriation (*adapted from Carroll et al. 2002*)

Level 1: Users are introduced to the technology and they are faced with the decision to adopt or non-adopt the technology during this initial encounter with the ICT. This decision is based on various influences and perceptions that act as filters.

Level 2: Once users decide to adopt the technology, they enter into a deeper level of use, the process of appropriation where they trial, evaluate and adapt the technology to suit their needs. At this level, users are encouraged to trial and experiment with the technology by a set of appropriation criteria. Users may adapt the technology to suit their practices or may adapt their practices to suit the technology. However, in some cases rejection or disappropriation of the technology may take place influenced by disappropriation criteria.

Level 3: Users' persistent use of the technology is captured. In this level users have integrated the technology into their practices and the technology is considered to be stabilized. Persistent use is "reinforced" by influences and changes in these influences may lead to either disappropriation or re-evaluation of the technology.

The MTA was developed by examining young people using mobile technologies. We were interested in understanding the influences and expectations of users during adoption through to long term use of a software application. We selected the MTA to interpret our results because it acknowledges that the status of a technology can change with time and because it describes the process of adoption and actual use of a technology. However, it was not initially clear how well the MTA would fit such a different domain.

## RESEARCH METHODOLOGY

We were interested in understanding the process of technology adoption through to long term use. Therefore, a longitudinal study was most appropriate. We examined users of a technology called EndNote in an educational institution. EndNote is a bibliographic software package that allows users to search online bibliographic databases, organize their references and images, and create bibliographies in documents. With permission from the facilitator of the EndNote training courses conducted by the School of Graduate Studies at the University of Melbourne, one of the researchers attended 5 training courses and recruited participants for the study. 14 participants (9 female and 5 male) agreed to participate. Twelve out of the 14 participants had no prior knowledge of the software. Participants were studied from the initial training course until 16 to 20 weeks of EndNote usage. However, not all of the 14 participants were interviewed and observed at every time point but attempts were made to follow up all participants. Some of the participants were either overseas or busy at critical dates but most claimed that they were using EndNote.

The research design used similar methods to that of the original MTA research, which included interviews, focus groups, scrap books and participant observations (Carroll et al. 2002). This approach allowed us to capture and triangulate participants' perceptions and expectations during their initial encounter with the technology after attending a training program and to track their likes, dislikes and actual experiences with the technology during continued use of the technology. Data were collected at the initial encounter with the technology and 3 subsequent times over the following 20 weeks.

Between 1 and 2 week after training, the 14 participants were interviewed. Some demographic information about their research, their prior knowledge about EndNote and the department or faculty they belong to, were noted. *Post hoc* recollection of how they came to know of EndNote and why they attended the training program were also collected. Issues such as their attitude and expectations during their initial encounter with the technology were explored - a time when they were faced with the decision to adopt EndNote.

Scrap books were given to all participants during the first interview with the aim of capturing and tracking participants immediate wants, expectations, likes and dislikes while actually using the technology, when the researcher was unable to be present. The scrap book was used to validate *post hoc* recollections made by participants (Carroll et al. 2002)

After 3 to 4 weeks, a focus group of 6 participants was conducted, in which users shared their experiences and expectations with each other (Vaughn, Schumm and Sinagub 1996). Issues such as users' experience, expectations, likes and dislikes about the technology, were explored.

At 7 to 8 weeks, 8 participants (5 from the focus group) were observed in their natural setting. They were actively probed about their actions, while actually using the technology. Use of this method facilitated collection of data about the role the technology played in users' research practices, their experience with the look and feel of the interface, the features they used to suit their needs and the reasons for selecting specific features.

Between 16 and 20 weeks, follow up interviews were conducted for 7 participants. The interview questions were related to how they used the technology in their research practice and their likes and dislikes about the technology and it features. They were also asked why they continued using the technology and what influences them to continue using the technology.

Data were collected using audio tapes and field notes. They were transcribed and descriptive codes were used to identify general and specific themes. A time ordered matrix was also used to display and analyse the themes (Miles and Hubermann 1994) from the data collected during different times in the research.

## RESULTS

In this section we describe how the participants used the technology EndNote to support their research practices and the influences that encourage and discourage their use at different times. We have organized the data according to the time of data collection.

### Decision to adopt EndNote

Participants attended a training program on how to use EndNote because they perceived it might be useful to them in their research. They were then faced with the decision whether or not to adopt this technology. Positive influences observed on the decision to use included subjective norm, easy access, expected usefulness and relative advantage.

**Subjective norm** is defined as a person's perception that most people that are important to him/her think that he/she should or should not perform the behaviour in question (Davis 1989; Viswanath et al. 2003). Most participants (13 out of 14) decided to attend the training because their supervisor and other peers suggested they use EndNote for their research program. For example, one participant commented: *"It was my supervisor primarily but other students in the department were also using it and found it useful and they recommended that I should certainly go for it"*.

**Access to the software** was free and easy. Participants could obtain a copy of EndNote from the library and download it on to their computers. This easy and free access to EndNote was one of the positive influences that led some participant's decision to adopt the technology. This is reflected in comments such as: *"...for PROCITE I would have to go and buy one on my own, but to use EndNote I had access via the library"* and *"I realized that it was available to everyone"*.

**Expected usefulness** is the degree to which a person expects that using a particular system would enhance his or her job performance (adapted from Davis 1989). After attending the training program, all participants stated that they expected EndNote to be useful to them in their research practice. For some, it would organize their references: *"I expect it to organize my stuff... EndNote is supposed to collect all my information and if I want to find something make it easier for me... help me with the citation and referencing and everything"*. For others, it was expected to be useful because of the features it possessed- the ability to track and retrieve information, search and sort information: *"... the thing I really like about it is you can put all your notes in and do a key word search and bring it all together... consistency and cross referencing I suppose ... I can see that it is going to be useful when I get an hand to it"*.

**Relative advantage** is the degree to which adopting or using the information technology is perceived as being better than using the practice it supersedes (adapted from Rogers 1995). Some participants perceived that using EndNote would be better than their prior researching methods, such as collecting references or articles manually from libraries and filing them. One of them commented: *"if I don't use EndNote I'll probably be sifting through lots of papers and get frustrated....EndNote is supposed to collect all my information"*. Another said, *"I can see referencing, I can see now, when, in my old research in my under-graduation, it was all over the place"*.

### Technology use between 1 to 2 weeks

During weeks 1 and 2, participants were trialling EndNote in its context of use: not in the training environment but in their everyday study environment. They used their personal notes and the instruction sheet provided to them during training. Positive influences that encouraged them to use the technology were integration, usefulness and the ability to change practices. The difficulty in learning to use and adapting the technology were prominent negative influences.

**Integration** with other software such as Microsoft Word in participant's research practice and the ability to link a Word document with the bibliographic software like EndNote gave the participants the perception that EndNote was compatible with their needs and past experiences. Comments such as *"I like that it actually ties in with Microsoft Word so when you are doing citing, it inserts there, it's well integrated"* and *"I find it very helpful, it is windows based and everything is just on the top, its there and I can click it"* highlight this fact. This is similar to compatibility, defined by Rogers in 1995 as the degree to which an innovation is perceived as being consistent with the existing values, needs and past experiences. Participants perceived EndNote to integrate with their research practices and the existing technology used by them.

**Usefulness** was a positive influence observed by participants. Participants expressed the technology to be useful in terms of useful features of the technology. Participants were able to search and find keywords related to their research topic. This is reflected in comments such as: *"Being able to search and find through keywords, that's very useful for me I think"* and *"Cite while you write feature which I found very useful"*.

**Ability to Change practices** to suit the technology was a positive influence observed by participants. Participants were in the process of trialling, exploring and learning to change their research practices to suit EndNote: *"...I have been entering whatever I have done, all my literature papers into EndNote"*.

**Lack of adaptability** of the technology to suit their needs was observed as a negative influence. During the process of adapting the technology, some participants ran into problems. For example, one participant commented, *"... I was filing a research application and when I tried to add the research protocol and the*

*reference list, the reference list went to the back of the application form, not within the same cell. I think I manually did it in the end". They ended up working around the problems instead of finding a solution.*

**Lack of ease of learning** to use the technology was also observed as a negative influence. Participants were in the process of learning to use EndNote. This is reflected in comments such as: *"I'm still learning it (EndNote), I have needed the manual to guide me through".* Participants found the technology to be unintuitive and not easy to learn to use: *"At the moment you feel like you have to look up and follow it step by step because it does not speak to you from the screen, it does not suggest where to go next".* The help feature on the software did not help them because they were not familiar with the terminology used: *"...when I looked at the HELP to find a field, I don't know what they called it. I would call it field but I think they call it something else... it's the jargons that make it difficult".* Participants expressed frustration when the instruction sheet given to them did not help them trouble shoot when they faced obstacles: *"... they provide you with the manuals, but sometimes the manuals do not help you to trouble shoot, there are certain areas where the manuals do not address".*

The ability to contact the trainer and attend training programs helped participants resolve some of the problems at this early stage as they trialled the new technology. Three participants contacted the trainer or attended more than one training sessions to further explore the technology. This is reflected by comments such as: *"...I think for me this was the time to identify those problems and ring up whenever I need assistance...this is what I have been doing...identifying the grey areas, identify the areas that I'm not too familiar with, and seeking assistance".*

### **Technology use between 3 and 4 weeks**

After 3 to 4 weeks use, most participants' expectations changed. This is reflected in comments such as, *"It's been hard in the sense, you expect a lot and now I'm learning that I can't get all that I want from it. It feels like as though I don't have any expectations from it now".* Frustrations were building up among participants: *"Just the little annoying things, they really add up...I'm not saying they should revolutionize it or something, I was not expecting that, but yeah, it's not performing".* Expectations were lowered and in some cases, participants decided to work around their problems. This is reflected in comments such as *"One of my expectations of EndNote was that I could just search around the database and find everything and download it into my computer... I was put off by it so I didn't do anything about it... what I have used so far is just to manually find what ever I'm reading and type it in".*

**Usefulness** continued to be a positive influence that encouraged participants to use the technology, even though expectations were lowered about what the technology can do for them: *"It's a way for me to organize my stuff, which I like... little pieces of references that I know is safely in one place and its easy to search and call up the subject list, or print out a bibliography or things I want to look up".* For some, the technology was useful because of some of the features it possessed. The features allowed them to easily adapt to their research practices. This is reflected in comments such as *"It has also helped because I have been doing a bit of writing as well, the cite while you write feature I have been using that quite well" or "I like the insertion of notes that helps when writing up...we won't have to worry about the style".* Despite problems, participants continued using the technology: *"For me it's the best bibliographic software there is at the moment...so that is motivation enough to continue to use EndNote... it is useful, having problems with it yes".*

**Lack of Adaptability** continued to be observed as a negative influence. The inability to adapt and customize some of the features led to frustration among participants: *"there are many fields that I don't use, I should be able to set it up so that I can put in the fields I would like to use" or "You should be able to customize something quite easily...there seems to be a lot of fields that you don't need it".* Having too many features did not help participants adapt the technology. For example, one participant said, *"There are too many fields some of which I don't know...some of the fields... you don't need them...also missing features that should be there".*

**Lack of easy integration** with other databases was another negative influence that was evident from participant's comments. While participants liked the ability of EndNote to tie up with Microsoft Word, they complained about the lack of information given to them on updates of filters that allow references to be accessed from other databases. One participant said, *"Obviously it has problems. If they have additional downloads, then they could just email the user, something to say, or automatically update".*

**Lack of ease of learning** continued to remain as a negative influence with time. Participants found it difficult to remember the number of steps they had to go through in order to get a particular task done. The inability for the technology to guide the user through the steps made participants frustrated: *"If you find out eventually what to do and you repeat it enough of times, then you can learn to do anything really. It takes so long, I find myself consciously trying to remember the steps".* If a technology is not easy to learn then it can influence users to start comparing other technologies *"nothing seems intuitive...and I have found myself trying the help all the time... I can't recall any other software that I have ever pressed HELP as many times as this one and even then it didn't quite help me".*

The availability of trainers or other on-line tutorials helped a few participants fix some of their problems. This is reflected in comments such as: "...I got only the first reference from the ones I marked. That was a problem. [Trainer] said 'down load the additional filter from the MU web cite...download the additional filter ...I don't know what I did wrong with the choice of style" or "I found myself running back again to those on-line tutorials".

### **Technology use between 7 and 8 weeks:**

At 7 to 8 weeks, it was observed that little or no adaptation of EndNote took place by participants. The participants used EndNote as a part of their everyday research practices. Activities with the technology were routinized and stable: "I'm not experimenting with it. I don't want to spend more time. I know the basic functions of EndNote, I know I need one and its there". The stabilization of the technology was attained as a result of mutual adaptation - participants adapted the technology to suit their needs: "...now I can just use EndNote and find the reference. It saves me time and the hassle of thinking where is the reference. It's also helped me standardize all my references in the bibliography so I don't have to worry about that as much as well" and participants adapted to the technology by working around it: "I think this whole technology is tuning me to work around it. I think it is dictating in the manner I should work which is ok with me. I like it at it goes". They had adapted the technology by selecting some of the features that suit their research practice and opted not to use other features that the technology provided. This is reflected in one such comment, "I have not used all the columns, some of them I think are irrelevant, may be not irrelevant but just that I don't have the data available to me... Basically I use certain features all the time such as title, author, year, journal, volume, issue, keywords... I hardly use the short title... It may be necessary later but at this point I don't use".

**Usefulness** continued to be a strong influence for longer term use. The technology helped participants organize their information efficiently: "It provides a platform to organize my reference...". EndNote continued to be useful in terms of the useful features that participants used. One participant noted, "That's what I wanted to do, cite while you write, have a database with references and to be able to put them into your Word document and standardize them. I really like that you can change it if you are writing an article and want a particular style you can change it and you don't have to manually go and change it".

However, we noted general negative influences such as lack of integration and ease of learning to use features provided by the technology, even after months of use of the technology.

**Lack of integration** with other databases remained as an issue for some participants. Frustrations were expressed when participants were unable to either transfer information from one software to EndNote or connect to databases related to the specific area of research. One participant said: "...I can't search from outside because I can't connect to those libraries. So I have to manually search outside using my music journals, they have their own databases. I will slowly switch between the EndNote and the databases and enter it myself. It's tiring though".

**Lack of ease of learning** continued to discourage participant's further exploration and adaptation of EndNote. Participants commented that EndNote did not guide them and they found it difficult to remember various steps they had to click before getting to what they wanted. For example one participant commented, "...that's not the way to go, because it's not in the screen, I have to memorize how to do all that, and if I go away for a few days and didn't remember the right button to push, I'm back again to the manual, because it's not like as its easily rememberable". Although easy access to the manual or the trainer may be available when problems need to be resolved, the technology may have to be user friendly and support ease of learning. This is reflected in one such comment, "Some of the features could be more detailed, like if you get stuck it should be able to tell you then and there, how to go about it... I think that was frustrating for me because you don't want to be calling the instructor all the time...I was reading the manual itself several times, its quite detailed but if you don't know what the problem is, then it does not make sense".

Some of the features were not used by the participants. All features were not used due to the lack of knowledge or further exploration of the features supported by the technology. For example, one participant said, "When I key in, there are too many entries in the bottom... alternate title, translator etc... they are not relevant to me. I would like to get rid of them in my course. Whether I can customize that I don't know, it's not obvious to me".

It is interesting to note that stabilization of the technology can be attained even though problems exist. Participants worked around problems they encountered during the process of appropriation. The negative influences did not stop any of the participants from using the technology.

### **Technology use after 16 to 20 weeks**

After 16 to 20 weeks, usefulness continued to positively influence participants' longer term use. In addition the ability to re-use and share information with others also acted as a positive influence encouraging long term use.

**Usefulness** continued to encourage use of the technology. This is reflected in comments such as: *"it's a useful tool and I have always thought it was a useful tool"* or *"There was a time when I thought it was creating more work, now it's actually going to work from me. It's saving time"*.

**Ability to re-use and share information** among others was observed to be a new aspect of usefulness. Some participants realized that the technology could be a common platform where large amounts of information can be collected, organized and later shared among peers working in the same area of research. For example one participant said, *"...other people working in other parts or areas can also be able to look at this...that's the reason I thought better pursue it if it's in a commercial format then other people can then use it for other purpose... that's why I ultimately persevered using it"*.

**Lack of adaptability** of the technology to suit their needs continued to be a negative influence for some participants. With time, they encountered new tasks or activities in their research practice. They had to further adapt the technology because they ran into problems with their existing use of the technology. For example one participant said, *"I thought I'd try to make my own style and did not know how to do it and the way I do it, I have to start from scratch and make my own style... there must be some easy way to do it"*.

**Lack of ease of learning** continued to negatively influence further exploring and adapting the technology. This is reflected in comments such as: *"they were in upper case or lower case and then when I go out and print it my bibliography, it would all be in lower case. It was really annoying me"*.

Easy access to ongoing training helped participants resolve existing problems and further explore and use the technology when new needs arose. Four participants attended a second training session to resolve some of the problems they faced while adapting the technology to suit to these new needs: *"... I enrolled into the course and found out that I could just have adjusted or modified one of the other styles"*. The training session helped users resolve frustrations that persisted earlier. For example one participant said, *"...a few niggling things were bothering me...So when I went for this course I asked her [trainer] and she said a few things and I clicked this one thing and it changed from lower case to upper case"*. It emphasized the capabilities of the technology to experienced participants: *"... I think I know now what the program limitations and my limitations are. Before, it was big frustration...but now I know what it can and can't do and I know I can't push it after more than it can give"*. Some of the integration issues were resolved after the participants attended the ongoing training session: *"Things like these- the importing and exporting...with the training it made it easy. This filter thing is not something that I would have known if I had not gone for the training"*.

The positive and negative influences we noted at different time points of use are shown in Table 1.

Influences	Decision to adopt	1-2 wks	3-4 wks	7-8 wks	16-20 wks
<b>Positive</b>	<ul style="list-style-type: none"> <li>Subjective norm</li> <li>Relative advantage</li> <li>Easy access</li> <li>Expected usefulness</li> </ul>	<ul style="list-style-type: none"> <li>Usefulness</li> <li>-Useful features</li> <li>Integration</li> <li>Changing practices</li> </ul>	<ul style="list-style-type: none"> <li>Usefulness</li> <li>- Useful features</li> </ul>	<ul style="list-style-type: none"> <li>Usefulness</li> <li>-Useful features</li> </ul>	<ul style="list-style-type: none"> <li>Usefulness</li> <li>-Ability to reuse &amp; share information</li> </ul>
<b>Negative</b>	None observed	<ul style="list-style-type: none"> <li>Lack of adaptability</li> <li>Lack of ease of learning</li> </ul>	<ul style="list-style-type: none"> <li>Lack of adaptability</li> <li>Lack of ease of learning</li> <li>Lack of integration</li> </ul>	<ul style="list-style-type: none"> <li>Lack of ease of learning</li> <li>Lack of integration</li> </ul>	<ul style="list-style-type: none"> <li>Lack of adaptability</li> <li>Lack of ease of learning</li> </ul>

Table 1: Positive and negative influences at different time points

## DISCUSSION

Our research addresses two major questions. First, how do users in an educational environment appropriate a technology over a period of time? This is discussed in the previous section. Second, what are the influences that encourage and support the process of appropriation and long term use of the technology? In identifying the



influences that encourage and support appropriation and long term use of a technology, we view our findings through the practice lens of the MTA, which has three levels (Figure 1).

With respect to the decision to adopt a technology (level 1), this study suggest that influences that support users' decision to adopt a technology may not be sufficient to encourage productive and long term use. Influences change with time and user needs. We found that perceived usefulness and subjective norm (Davis 1989; Venkatesh et al. 2003) or relative advantage (Moore and Benbasat 1991; Rogers 1995) supported user's decision to adopt the technology. In addition we found that easy and free access to a technology was a positive influence. Others have noted that an initial training program can be an important influence in the formation of perceptions and attitudes about the technology (Raymond 1990; Venkatesh 1999; Xia and Lee 2000). We also noted that expectations were high during the initial use, after initial training, and suggest that these high expectations may have been an outcome of effective training.

Our study revealed that some of the positive influences that encouraged adoption such as subjective norm, relative advantage and easy access to the technology did not appear to encourage actual use. As users adapt to the technology and adapt the technology to suit their needs (level 2), their expectations change with time. This supports the notion of a certain "*window of opportunity*" when adaptation is most likely to occur (Holstrom 1999; Tyre and Orlikowski 1994). New positive influences such as usefulness expressed in terms of useful features, ability to integrate with other technologies and change practices effortlessly seemed to be important in encouraging long term use.

In addition, we found that negative influences persisted over time, decreasing expectations but not stopping use. For all EndNote users, the positive influence of usefulness outweighed the negative influences, such as the lack of ease of learning, integration and adaptability. Additionally, the easy accessibility to trainers and training programs appear to have been a strong influence that encouraged users to overcome these negative influences and continue using the technology.

With respect to stable use of the technology (level 3), our findings suggest that users established ways of using the technology by working around the problems they faced earlier or by lowering their expectations (Tyre and Orlikowski 1994). In our study we observed that use of the technology stabilized in weeks 7-8. Users chose to use some features to suit their research practices and temporarily rejected some other features. Adaptation took place in different forms: changing the physical configuration of the technology and substantially altering their existing research practices to suit the technology. Usefulness continued to positively influence long term use of the technology.

However, can we conclude that once a technology is stable in use, no further appropriation can takes place?

Our findings suggest that there may be multiple windows of opportunity for appropriation even after a technology-in-use is stabilized. Deeper evaluation of longer term use in our study (weeks 16-20) revealed that a stable technology in use can re-enter the process of appropriation. This re-entry has been noted in some previous findings (Carroll et al. 2002; Tyre and Orlikowski 1994). But in our in-depth study, we observed that stabilization of a technology may only be a temporary plateau. The need to explore and further adapt the technology based on emerging events and the need to resolve some of the problems that may have been overshadowed previously, forced some users to further appropriate the technology. Strong negative influences such as the lack of adapting the technology to new needs and the lack of ease of learning to use the technology did not stop long term use. We found that the ability to re-use and share information, a new aspect of usefulness, emerged as a strong positive influence, well after the plateau. It appears that the positive reinforcers are stronger than the negative influences. In addition, we found that the availability of an ongoing training program helped overcome the negative influences and acted as a "facilitating condition" (Thompson et al. 1991) that influences further appropriation.

If "*An interruption provides only a window of opportunity [and] the opportunity must be exploited*" (Tyre and Orlikowski 1994), then how can we exploit these interruptions or events to further support adaptation as a process of appropriation?

Our findings suggest that one way of encouraging further appropriation and avoiding stagnation of a technology is to provide ongoing training. Users in this case study attended an advanced training session which was voluntary. The training sessions helped them resolve pre-existing issues and further adapt the technology to suit ongoing activities in their research practices. Therefore, we argue that designers, trainers and managers need to be aware that providing training for users during the implementation stage alone may not be sufficient to support and improve persistent and long term use of the technology. Ongoing training may be a key factor in encouraging productivity and user satisfaction.

## CONCLUSION

This paper has examined the process of adoption through to long term use of an application software in an educational setting. It has captured changing expectations, likes, dislikes and needs of 14 people over a 5 month period. We have found that influences that encourage adoption of a technology may not be sufficient to sustain long term use. The overriding influence leading to longer term use was the usefulness of the technology. As users moved from the initial adoption to longer term use, new aspects of usefulness emerged. In addition we have found that stabilization of a technology may only be a temporary plateau. Changing needs forced some users to re-enter the process of appropriation from a stable use of the technology. Training supported this re-entry, drawing attention to the crucial role played by ongoing training services in encouraging the process of appropriation leading to persistent and productive use of a technology.

In future research, we plan to conduct case studies to investigate longer term use of a range of technologies in a variety of environments.

## REFERENCES

- Brown, S.A., Massey, A.P., Montoya-Weiss, M.M. and Burkman, J.R. (2002), 'Do I really have to? User Acceptance of Mandated Technology', *European Journal of Information Systems*, vol. 11, pp. 283-295.
- Carroll, J., Howard, S., Peck, J. and Murphy, J. (2002), 'A Field Study of Perceptions and Use of Mobile Telephones by 16 to 22 year Olds', *Journal of Information Technology Theory and Application (JITTA)*, vol. 4, no. 2, pp. 49-62.
- Carroll, J., Howard, S., Peck, J. and Murphy, J. (2003), 'From Adoption to Use: The Process of Appropriating a Mobile Phone', *Australian Journal of Information Systems (AJIS)*, vol. 10, no. 2, pp. 38-48.
- Ciborra, C.U. (1996), *Groupware and teamwork*, John Wiley & Sons, New York.
- Davis, F.D. (1989), 'Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology', *MIS Quarterly*, vol. 13, no. 3, pp. 319-339.
- Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. (1989), 'User Acceptance of Computer-Technology - A Comparison of 2 Theoretical-Models', *Management Science*, vol. 35, no. 8, pp. 982-1003.
- DeSanctis, G. and Poole, M.S. (1994), 'Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory', *Organization Science*, vol. 5, no. 2, pp. 121-147.
- Holstrom, J. (1999), "'It's as if somebody slammed the door" On the limits of Organizational Change Around Information Technology', *Proceedings of the 7th European Conference on Information Systems*, vol. 1, pp. 320-329.
- Karahanna, E., Straub, D.W. and Chervany, N.L. (1999), 'Information Technology Adoption Across Time: A Cross-sectional comparison of Pre-adoption and Post-adoption Beliefs', *MIS Quarterly*, vol. 23, no. 2, pp. 183-213.
- Leonard-Barton, D. (1988), 'Implementation as Mutual Adaptation of Technology and Organization', *Research Policy*, vol. 17, no. 5, pp. 251-267.
- Majchrzak, A., Rice, R., Malhotra, A. and King, N. (2000), 'Technology Adaptation: The Case of a Computer-supported Inter-organizational Virtual Team.' *MIS Quarterly*, vol. 24, no. 4, pp. 569-600.
- Miles, B.M. and Huberman, A.M. (1994), *Qualitative Data Analysis*, 2nd ed., SAGE Publications.
- Moore, C.G. and Benbasat, I. (1991), 'Development of an Instrument to Measure the Perception of Adopting an Information Technology Innovation', *Information Systems Research*, vol. 2, no. 3, pp. 192-222.
- Raymond, L. (1990), 'End-user Computing in the Small Business Context: Foundations and Directions for Research', *Database*, vol. 20, no. 4, pp. 20-26.
- Rogers, E.M. (1995), *Diffusion of innovations*, 4th ed., Free Press, New York.
- Taylor, S. and Todd, P.A. (1995), 'Understanding Information Technology Usage - A Test of Competing Models', *Information Systems Research*, vol. 6, no. 2, pp. 144-176 .
- Thompson, R.L., Higgins, C.A. and Howell, J.M. (1991), 'Personal Computing; Towards a Conceptual Model of Utilization"', *MIS Quarterly*, vol. 15, no. 1, pp. 124-143.
- Trigg, R. and Bodker, J. (1994), 'From Implementation to design: Tailoring and the Emergence of systematization in CSCW', *ACM conference computer-supported cooperative work CSCW 94*, pp. 45-54.

- Tyre, M.J. and Orlikowski, W.J. (1994), 'Windows of Opportunity: Temporal Patterns of Adaptation in Organizations', *Organization Science*, vol. 5, no. 1, pp. 98-118.
- Vaughn, S., Schumm, J.S. and Sinagub, J.M. (1996), *Focus group interviews in education and psychology*, Sage Publications, Thousand Oaks.
- Venkatesh, V. (1999), 'Creation of Favourable User Perceptions: Exploring the Role of Intrinsic Motivation', *MIS Quarterly*, vol. 23, no. 2, pp. 239-260.
- Venkatesh, V. and Davis, F.D. (2000), 'A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies', *Management Science*, vol. 45, no. 2, pp. 186-204.
- Venkatesh, V., Morris, G., Davis, G.B. and Davis, F.D. (2003), 'User Acceptance of Information Technology: Towards a unified view', *MIS Quarterly*, vol. 27, no. 3, pp. 425-454.
- Xia, W. and Lee, G. (2000), 'The Influence of Persuasion, Training, and Experience on User Perceptions and Acceptance of IT Innovation', *Proceedings of the twenty first International Conference on Information Systems (ICIS)*, pp. 371-384.

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