DEVELOPMENT OF USER COMPETENCE

This paper describes the process through which User Competence is developed. Results show a variety of drivers of competence updating, and methods through which updating is accomplished. In addition, the findings suggest the process is neither entirely rational nor simple. The complexities we found suggest that relying on individuals to update their skills on their own, a practice becoming increasingly common in organizations, leads to satisficing on skills rather than developing high levels of deep skills.

Introduction

Realizing the value of information technology investments requires users who effectively use the systems available to them. Effective use means much more than simply “more use,” as most studies of IT adoption conceptualize acceptance. It implies using the technology in appropriate and productive ways, with the right amount of effort (neither more nor less than is needed). In order to achieve this effective use, users must possess, among other things, an appropriate level of competence in the technology.

Most studies of user competence (UC) have been conducted within the IS training literature. The focus of these studies has been on the depth of knowledge developed within a specific application domain. They are predominantly experimental and often involve comparing training methods to see which are most effective in developing competence (e.g., Yi and Davis 2003). They also examine the cognitive and affective factors that influence the development of competence (e.g., Martocchio and Judge 1997).

Other studies (e.g., Blili et al. 1998) have looked more broadly at UC. These studies, often defined around “computer literacy,” have been concerned with defining what it is to be computer literate, and understanding which people become most computer literate. These studies are typically survey based, and examine demographic and behavioural differences between more and less computer literate individuals. (Munro et al. 1997) provide a broad definition of UC, incorporating the breadth of domains known by the individual, their depth of knowledge within the known domains, and their ability to creatively apply the technology, or finesse.

What has been missing from the literature, however, is an examination of the process by which users learn on an ongoing basis. The purpose of this paper, then, is to extend prior work on user training and learning, by providing a description of the formation of UC from a process perspective using rich qualitative data. A conceptual model is developed from interview data and antecedents of UC are considered. What elements are involved in the development of UC? How do they interact and why does that occur?

Background Literature

Our intention in this research was to adopt a relatively grounded approach to theorizing. An advantage of qualitative data is the rich description that it provides and the ability to understand the phenomenon from the perspective of the individual, rather than the researcher. Nonetheless, we entered into this research with some preconceived ideas about what we might find. In addition to our perspectives on the literature above, we were influenced by research on self-management, and by Vandewalle’s research on goal orientation (e.g., Vandewalle 2001).
Self-management is a means by which people “engage in actions designed to change or maintain [their] own behaviour” (Cole and Bambara 1992, p. 193). Self-management is a theoretically strong, empirically proven method of increasing positive behaviours and decreasing negative behaviours. Both Social Cognitive Theory (Bandura 1986) and Goal Setting Theory (Locke and Latham, 1990) provide theoretical support for self-management.

Self-management involves assessing problems, setting specific difficult goals in relation to those problems, monitoring ways in which the environment facilitates or hinders goal attainment and identifying and administering reinforcements for working towards goal attainment. (Frayne, 1986). Self-management of user skills thus involves identifying needed skill levels, assessing current skill levels against desired skill, setting both long term and immediate goals for the attainment of skills, identifying strategies and resources for building skills within the organization, identifying barriers to achievement of skills, and identifying and administering reinforcements for working towards the goals. Related to this process of setting and achieving goals is one’s goal orientation, or the orientation held during goal attainment. Two distinct goal orientations are that of performance orientation and learning orientation, which are, respectively, preferences for demonstrating or developing competence (Vandewalle, 2001).

Given the climate in today’s organizations, where most learning about IT comes from self-training (e.g., Gravill and Compeau 2003) and where users are often expected to manage their own capabilities (e.g., Hurley and Cunningham 1993), we believed that a self-management perspective, and its related concepts, would be well-suited to examining UC development.

Research Methods

Data for the study were drawn from 19 semi-structured interviews1 with employees of an international chemical company called ChemCo2. ChemCo is a large multinational corporation, producing chemicals and polymers. The organization used information technology extensively and had recently undergone an SAP upgrade. Many on-line IT support and training programs were provided to employees. ChemCo actively prescribed self-management practices for its employees, supported by a management by objectives (MBO) program.

Respondents were chosen based upon their UC score from a previous study. We began by interviewing the extreme user profiles along the breadth and depth dimensions (high, high and low, low) to get a sense of the range of user behaviours within the organization; we then proceeded to interview a variety of the represented combinations. Office workers and plant operating staff were interviewed in relation to their office technology usage. All participants used office technology to some extent as part of their jobs. Table 1 describes the respondents.

Interview questions were drafted with our previous knowledge of the theoretical literature and refined in initial discussions. Interviews averaged 1-2 hours, were tape-recorded and hand recorded, and were transcribed quickly. Poor recording quality on three tapes led us to place more reliance on hand taken notes; however, we felt that an accurate picture was achieved here.

Data were content analyzed following the techniques of Weber (1990), resulting in 18 coding categories involved in the formation of User Competence. A complete list of the coding categories is available upon request. Coding was then conducted in NVivo software (QSR

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1 We had originally scheduled 20 interviews, but one was cancelled due to a plant emergency and we were not able to be reschedule it, thus there were 19 interviews.
2 ChemCo is a disguise necessary to protect the identity of the organization and the participants. Identifying information is thus difficult to present without divulging this identity, however, where possible organizational details are offered.
Software®, version 1.3) and merged across the three coders. Various checkpoints and inter-rater agreement tests occurred, ensuring that the three coders aligned their coding as best as possible. For instance, after the initial alignment exercise, coders agreed on over 85% of the coding assignments. Within-case summaries and between-case summaries were developed for the coding categories around the concepts in the research model. Illustrative cases for overall coding categories were identified and model building discussed.

Results

Our interviews and our analysis of the discussions, combined with our review of the literature, led us to formulate a model of the development of user competence (Figure 1). An individual, operating in a particular environment, has at any given point in time a level of competence. Various “Motivators or Drivers” serve as triggers for that individual to develop new skills or improve existing skills. These motivators or drivers interact with an individual’s “Self-Assessment” of their skill to produce a “Felt Need for Updating”. The need perceived by the individual results in their undertaking certain “Updating Activities” which ultimately results in their attaining a new level of user competence. A number of “Barriers or Deterrents” were identified which either reduce the degree to which a felt need translates into updating activities or which decrease the likelihood that the updating activities would actually result in improved skills.

Motivators or Drivers

What motivates users to update their technology skills? When we asked users about their competence histories, we asked them to identify the triggers for changes in their skills. We also looked for statements about drivers or motivators of skill development throughout the interviews.

The findings can be summarized in 5 categories. Users are driven to update their skills when they change jobs or roles and the new position demands different skills (job/role change), when they confront new tasks at work that go beyond their current skill levels (task demand), and when the nature of the technology they are working with demands new skills (technological demand). These were expected categories, consistent with a rational view of technology updating. Two additional categories reflect less instrumental views; some users updated because they were personally interested in technology and in learning about it (personal interest), while others developed their skills to be consistent with their self-image (image/identity).

Job/role change. These drivers included work-related roles as well as roles outside the work environment. One individual recalled: “So, I had a temporary position first of all – I had a friend and I went to her house and she showed the basics of her computer so I could do word processing because I knew it would be expected of me when I went to ChemCo” (#193). Thus, faced with a new job that would demand new skills, she was motivated to pick up the skill by learning from a friend. Several quotes demonstrate this sort of process.

Other users had hobbies or interests that demanded they use a computer. One user’s son was on a cross-country bicycle trip. She learned to use the Internet to keep in touch with him and to follow the progress of his tour. We coded this as a role change, rather than personal interest. While it relates to something personal (the individual’s role as a parent), it is not an interest in the technology per se, but rather an outside interest that drives a need to learn about a technology.

A change in role can also result in a reduction in skills, when the skills are no longer used. A manager illustrates this as follows: “For my next ten years, um, I was a practicing engineer so I was at that. That [UC] went up significantly and, um, and then I became a supervisor, and that one went down like this” (#089). Thus, the influence of role on skills works
both ways – changes in role can, over time, drive increases or decreases in UC. The manager after a period of time lost his engineering skills, whereas the paralegal was building skills.

**Task Demand.** We had originally combined role drivers and task demand drivers of UC, under the heading of “job need”. But we found subtle differences in the responses that led us to separate these categories. While role changes influence skills through the tasks that are done on the job, when people talked about role changes, they did not generally reflect on specific tasks. Thus, the changes due to role drivers appeared to be more passive in nature – I have a new job, I guess I’ll have to change my skills.

Task demands were more immediate and more active drivers of UC. For example, one user commented: “...it may be an emergency situation within the plant. You just learn from experience type of deal when you have to” (#6). In this case, a specific task demand drives immediate learning. One of the participants commented that this was not always the most effective way to learn:

> Need [drives learning]. The big thing I would change that I haven't done over the years, I haven't really set aside the time to learn. It's like...instead of learning to drive your car, you jump in the car and learn as you go. And sometimes you learn enough to get by but you don't really know why you're doing what you're doing. (#440)

Thus, while the task demands gave an immediate motivation to learn, and essentially forced the users to develop skills, it was sometimes seen as a less thorough approach to learning.

**Technological Demand.** Technology itself also drove the users to develop their skills. Changes in technology (new systems or upgrades) required users to learn new things. Many respondents reflected on the introduction of PCs into the organization and how that forced them to learn new things. Others talked about how the advent of the Internet pushed them to learn new things. Not surprisingly, system upgrades resulted in less radical changes in skills than new system implementations. Users expressed both positive and negative views of the impact of technology on their skills. On the positive side, one user commented that: “we got more powerful computers around 1990. We could do more. We could do spreadsheets. Not everyone had Lotus prior to that but I remember I got Lotus. I was very excited 'cause I could do spreadsheets.” (#4)

Others saw the technological driver in much more negative terms: “Well, it [SAP] is too intricate. It is very difficult to learn, and they keep on changing it constantly. How can you learn something when they are always changing it? (sounds frustrated here - voice rises) You just finally get it down pat and they change it again!” (#246)

Another aspect of technological demand was evident in some interviews. A number of users described situations in which the characteristics of technology or problems with technology drove them to learn new things. Well, I know I've had certain problems. Desktops have taken a while to get fixed. I always ask them, so what did you do, give me an idea, and they will tell me. ... So, yah, I use it to learn. (#89)

**Personal Interest.** For some users, it was not external pressure that drove them to learn new things. Rather they were driven (at least partly) by an interest in learning more about the technology. One user described programming as *hobby stuff*, which he used to locate games on the company mainframe computer, as opposed to something that he needed for his job. This user had cultivated an interest in knowing how the technology worked and found it interesting to pursue this interest, regardless of whether it would help in his job. Other users echoed similar thoughts; they “like to see what else it can do” (#90, 193). Several also reflected on how they would always learn more if they were interested.
For other users, interest was raised in a negative way. They clearly indicated that they did not have an interest in technology for its own sake, and would only pursue developing skills if it were needed in some way (the first 3 categories). One user, a systems analyst, described it as follows: “I am sick of computers from a personal point of view. [...] I know everybody's flabbergasted, but [...] I don’t have a PC at home and [...] it’s not a hobby at all.” (#387)

**Image/Identity.** The first three drivers represent relatively instrumental drivers of technology change. The fourth one adds in a more intrinsic dimension but is still very explicit. The final category is more implied in the language used by the users. Several users used descriptors such as diva, computer genius, data boy, and guru to describe people (both themselves and others) who were skilled in the use of technology. Others used terms like dinosaur to describe those who lack up-to-date skills. These references suggest that, at least at some level, people define themselves by what they know about technology. The language here reflected “I am” rather than “I know”.

Image/identity statements also reflected a concern, among some users, about asking for help. They felt if they were seen as unknowledgeable, they would be perceived as stupid. One user described herself as “stumbling around, lost” (#176), another said she did not want to be “an idiot” (#341). Others with a more positive attitude also conveyed this idea. One user suggested that “no matter how little you know, there is always someone who knows less” (#90), implying that it is important to him to know more than others around him.

**Self-Assessment**

Given the influence of self-management perspectives on our work, this aspect of the model was of particular interest to us. In a self-management context, individuals must assess their current skills in relation to the skills required for their job, in order to determine what steps they must take in order to achieve a fit between their capabilities and their needs. Yet previous research (e.g., Marcolin et al. 2000) suggests that individuals’ self-assessments are not always accurate. Understanding, then, how people think about their skills and how this influences the process of their competence development was a key goal of this research.

**Definition of Competence.** We asked the users to assess their competence in broad terms, and in two areas (spreadsheets and word processors). From these discussions we developed a sense of their capability. But we also discovered differences in how they conceptualized their capability, which serve to explain one of the reasons why self-assessments are often “inaccurate”. In our interviews we observed three different ways in which people think about their competence. Their assessments of themselves, and the accuracy of their assessments from our perspective, vary depending on which definition they used.

**In relation to job needs.** The first definition of UC relates to job needs. Users who subscribe to these definitions typically responded to our question of “how competent would you say you are when it comes to technology” with examples that relate specifically to their ability to get the job done. Within this category were two variations. The first, which we refer to as **Sufficient**, means that they define themselves as competent if they have sufficient skills to get the job done. As one interviewee put it: “So, I'm not a super-user of Excel - I know enough of the commands and structures to do what I need to do”. (#90)

The second group was similar, but included within it a consideration of whether they were getting the job done efficiently and effectively. We labeled this group as **Proficient**: these users considered themselves competent if they were proficient in the use of the technology. One user said: “[I] do not have more skills than necessary - the more skills you develop the higher your proficiency the more you can do” (#378)
In relation to peers/others. While some users seemed to assess themselves in relation to their ability to complete tasks, others tended to describe themselves relative to their peers or other people. Thus, when asked about their level of competence, they responded by saying how much they knew relative to the people they worked with: “I would say above average. A lot of people come to me now and ask, you know, can you find so and so and on the Internet for me.” (#427). This user defines himself as competent in using a browser because people come and ask him questions.

In relation to technology potential. A final group of users did not simply reflect on their ability to complete tasks or their knowledge relative to others. Rather, they considered what they knew, relative to what was possible with the technology, or its potential. One user, in describing the scoring process on the online training the company used, noted: “Competencies will range from sometimes 70 to pass sometimes 90 to pass. I don't know if that training helped me. A person had to have a 75 to pass and that's 25 % they don't know” (#6).

This user rated herself as quite low on UC. It is not surprising that she would feel this way, given that her definition of “high” seems to be knowing 100%. A second user also expressed this sort of definition, though at a less extreme level:

You can never say you're over skilled cause, you know there are so many different things that I probably could do better that I don't know how to do better because I don't know the options out there. You know some people would be working on a spreadsheet for example and they'll still take 2 hours to do something that can be done in 5 minutes but they'll never know (#258)

This quote includes an aspect of the Proficient definition as well as the Technology Potential, but seems to hinge on the problem that you do not know all of the options, and thus was considered as representing a definition geared to the Technology’s Potential.

Thus, when asking users to do a self-assessment, it is important to realize that the meaning of competence is different for different users. They are not answering the same question. Moreover, only one group (the smallest) rated their competence based on the potential of the technology. This helps to explain why users’ self-assessments have been found to be different than scores on knowledge tests (e.g., Marcolin et al., 2000; Gravill et al., 2001).

Confidence. Confidence in one’s ability, or self-efficacy, also plays a role in individual self-assessments. Many users, when discussing their capabilities related stories that showed how their level of comfort with the technology influenced how they felt about their skills.

Felt Need for Updating

The literature suggests that users evaluate the skills they need for the job, then evaluate their current level of skill and if the current level of skill is deficient they update their skills. We found this to be partly supported, as discussed above. But we also found a different outcome of this assessment. Sometimes, when users judged their current skills as deficient, they reassessed their need, rather than updating their skills. One user commented, I have an Access database on mine but I don't use a database that often. I'm not in that type of work. If I want to do a lot of that type of work I'll just use Excel, because I tend to use it and then for maybe a year and that's about it and then it gets dropped (#89). He starts by saying he does not need Access because he’s not in “that type of work”. But then he says he does (sometimes) need to use Access – it is the correct application for the task. Thus, it is a skill that is needed for his job. But since he does not know how to use it, he decides that he does not need it.

The concept of a skill payoff also factored into this felt need for updating. Skill payoff was an evaluation of the payoff in relation to their job performance for building a skill set. The
payoff could be immediate or longer term and could bring a positive or negative benefit. Users expressed statements like the following:

So I think a person needs a lot of skills to successfully do this job. And you have to have good basic skills and a desire to expand your skills to succeed. (#4).

Yes, a job position level as opposed to skill level. If you don’t see a chance for advancement then what’s the point. If everybody is satisfied with the job you’re doing, then that’s where you are going to be. You go through a career dialogue and they say ‘we expect you to do this’ and that’s motivation to improving your skills or acquiring the necessary skills to get to that point (#6).

What this suggests, from a practical standpoint, is that the “need” to use something for the job is not a clear and unambiguous thing. It is determined by the user in response to instrumental drivers (task demands, job/role demands, technological demands) as well as personal interest and maintenance or development of an acceptable self-image (image/identity). It is influenced by how one defines competence (in relation to tasks, peers, or technology potential) and it changes depending on how one assesses the fit between the required skills and one’s current skills. Understanding this more complex view of the need for updating is important if we are to understand the behaviours of users as they develop their skills over time.

Updating Activities

Having recognized a need for new skills, the users undertook a variety of activities to change their competence. To identify the activities that the interview participants associated with their own competency development, the interviewees were asked to describe how they developed their overall IT competency. As well, throughout the interviews, participants volunteered methods for learning that they preferred or disliked. Four main learning methods appeared to be common among participants. These included: learning from courses, learning by doing, learning through social networks (peer pods) and learning through exploration.

Learning through Courses. Of all methods, learning through courses was mentioned most frequently. Approximately two-thirds of the interviewees indicated that training was a beneficial means of developing competence. One interviewee explained the benefits of classroom training as follows.

I find you can always tell the difference between someone who teaches themselves an approach or a system and someone who's learned in a classroom. There's really a lot of benefit to learning in the classroom - you learn the right way and you don't make a lot of dumb mistakes and you don't learn incorrect procedures because sometimes that can take quite a while to re-learn. So I think that is why my preference is the classroom. (#4)

Others explained that courses were good in providing an overview of the software functionality but that the ability to apply the software in their own contexts came through other means. “Yeah. And I found them really helpful. But I find that you don't learn a lot of the day-to-day stuff in those courses but you learn what the programs are capable of.” (#193)

In these passages, training is seen more as a way to increase breadth of knowledge about the technology (that is, understand the broad range of its functionality) rather than to increase finesse, or the ability to apply that technology in different ways and in different contexts. This is in keeping with our finding that those interviewees with low competency breadth were somewhat more likely to speak positively about training (5 of 6) than were the interviewees with high competency breadth (6 of 10).

Other interviewees indicated that training increased their depth of knowledge of particular software packages when the training followed a period of use.
We've already been playing around using it trying to do real work. So we've been asking questions....the value of that training became the opportunity to ask questions about something you already played around with. And say, well, uh, yeah, this didn't seem to work as expected. What's going on here. So, it's more like feedback. (#144)

Overall, while most interviewees were positive about training, approximately one third of the interviewees indicated training was not always the best way to learn. One explanation given was that training cannot duplicate the real world conditions under which people use the technology. “Nine times out of ten when you go to IT training, you're on an IT training server or system, not your own, so when you go and do something, practicing in training, then you have to go back into it again in your own system, I think that's a total waste of time, right?” (#427)

Learning through Doing. The most often discussed alternative to learning through training was learning through doing. Most people recognized that much of their competency development had come about through their application of the technology in their own lives. Learning through doing, for many of the interview participants, was very much a process of trial and error supported by manuals and other individuals. “Yah, and this was all self-learned. It was just like, give me the manual and I'll sit down and read or talk to somebody. There was a lot of trial and error and a lot of long days.” (#89)

For some, learning in this manner was the preferred way of learning, often because the learning could be targeted to a specific (non-abstract) problem. For example, “the most important way is by doing. I need to have a problem at hand, I can't do a hypothetical kind of problem. It needs to be useful, I need to see that it's useful, and that it's challenging.” (#89)

For others, however, learning by doing, while a reality for their work lives, was not a preferred way of learning. For example, when specifically asked if learning by doing was his preference, Interviewee 177 said, “Ah, no. I think it would easier if you were actually trained to do it.” A few people concurred that learning through doing was not always the easiest way to develop UC but suggested that the difficulty of the process seemed to help them carry their learning forward. Interviewee 440 described his process of learning through doing in a particularly difficult situation as follows:

“I find, I think, I feel really bad because I think this is a waste of time, I've been struggling now for three hours. That's three hours wasted of paid time. I've learned absolutely nothing. I've learned to be a detective …like my friend on the police force. And then I dig out the manual and I go right back into basics and work back from basics. And I think gee, this is really frustrating. In a way it helps, usually once I've learned something and I've had that bad experience it usually sticks. I look on it as a learning opportunity. I certainly don't welcome it, but I still learn from that.” (#440)

One interviewee explained that this trial and error process was possible for him because he wasn’t afraid of the consequences of making a mistake nor was he uncomfortable with admitting that he didn’t know something. “Hands-on. I'm a hands on guy. I don't worry about not knowing. I just sit down and see what happens. What's the worst thing that can happen?...If it doesn't work I turn it off, then I reboot and start fresh again. And I remember, oh I did something wrong here someplace?” (#90)

Another interviewee echoed this sentiment, indicating that her comfort with the trial and error method came from not being afraid that she could somehow harm the computer:

193: “So, just by figuring out, by going and finding the search button and you know playing around until I get what I needed.”

Interviewer: How comfortable were you doing that?
193: No fears. I kind of have the feeling that the computer is going to warn me if I'm going to do anything that's going to harm it. (#193)

**Learning through Social Networks (Peer Pods).** Another important learning method that emerged from the interviews was learning through an individual’s social network, which we have termed “peer pods”. Reliance on peer pods for learning came in two different flavours. First, interviewees suggested they sought out advice from knowledgeable peers, very often to support the individual’s learning through doing. “Well, first of all I rely on people. That's number one. [A] dozen already know that technology so I'd go to him or her and ask for help. You know, if I can't find anybody to help me I guess I have to go elsewhere.” (#390)

Interviewees also indicated that just watching others use the technology gave them ideas about new ways to apply the technology in their own jobs. For instance,

> And he says 'that's all I need. I don't need to know any more'. And then he was in my office and I was doing something, and he says 'oh, I didn't know you could do that'. You know, and its learning as you go too, because he did something the other day too, and I go, 'oh, that's interesting'. I haven't tried that before...do that function. I knew the function worked but I never did it in the way he did it...so I learned something new from him. (#90)

Almost all interviewees mentioned learning from others as an important part of their UC development. However, a few challenges were also brought forward. The first was that if you were one of the people often approached for help, this could consume a lot of your time despite the fact that providing this support was not an official job duty.

**Interviewer:** How much of your job do you spend helping other people using information technology?

90: I try to not do it too much any more. I used to do a lot of it, but it eats up a lot of time from my normal work. So, the odd time if I hear somebody struggling I'll just kind of...[whispers...showing that he just gives quiet help]. (#90)

A second issue that emerged was that reliance on peer pods required individuals to know both who knew what in the organization and who was willing to help others. “It's just cause...you develop contacts, right: your IT contacts, your accounting contacts. Like a lot of people are flaky...you know, won't do stuff. But you find these contacts and they do the job. So fortunately I have this lady. Another IT contact. But I know a lot of people that are frustrated”. (#258)

Some parts of the organization seemed to openly acknowledge – and officially support – peer pods by providing specific training to certain individuals. When I get in trouble I go see these guys, you know, or anybody in the group gets in trouble they go see one of these guys that we have given the extra training to. And that's more, it's included in their job description, where my computer skills wouldn't be. (#6)

A related form of learning through social networks that interviewees discussed was their reliance on the organization’s support centre or help desk. Creating a help desk is really an organization’s way of formalizing a specific group whose official role it is to provide this type of support to the organization’s employees. And, while some interviewees indicated that they were successful in learning from this group, this was not without challenges. For example:

> “The helpdesk is OK but it's almost uh, I'm after a discussion from the helpdesk, I get help, but I don't get discussion ... because they don't have the time. I always like to know why. It's never why, it's do this, do this and you've got it”. I think...I didn't really learn anything from that. Next time that comes up, I'm back at square one again because I
haven't learned anything. All they've done is gotten you out of a hole. Press this button, do this, do that." (#440)

The problems identified by these individuals and others suggested that, while the help desk could be a useful resource for solving specific issues, the opportunity to learn from them was often not present. Individuals then relied more heavily on their immediate social network.

Learning through Exploration. The final learning method that was discussed across multiple participants was learning through exploration. This method differs from learning through doing because, while the individual is exploring the technology on her or his own, they are not applying the software within a specific real-life context.

“...if I have a free moment, I don't mind exploring the software to see what other capabilities it has besides my normal function. I mean, I can probably just get away with 3 commands in Microstation - draw straight line, draw circle, and delete. For all of that, I mean, I could draw everything I want. And...but there's more to it, there's shading and three-dimensional stuff and ... I haven't even touched the three-dimensional stuff yet. It's still confusing to me. Well, I haven't had time to play with it either.” (#90)

Almost universally, those who discussed the notion of learning through their own unstructured exploration of the technology called it “play”. We saw this in Interviewee 90’s comment above and in Interviewee 4’s comment, “Oh, yes, I'm bad for it. Yah, I get a new toy I just want to play with it”. This association of exploration with play, however, may make it difficult for individuals to use this learning method in a work context because it is not seen as an appropriate and productive way to spend their work time. This may be one reason that this was the least discussed of the four identified learning methods.

Barriers or Deterrents

We asked the users to comment on both the things that facilitated or helped their learning and the things that deterred their learning or represented barriers. The facilitators largely related to the ways in which they liked to learn, and were thus discussed under Updating Activities. In total, they identified 12 different barriers to their development of skills (Table 2). The most important barriers to learning related to access to training and/or training materials, access to technology, time, lack of company value for learning, and the pace of change in technology. The last two were seen to exacerbate the time problem.

This company provided a great deal of training for employees. Online training was available for their SAP upgrade, and users were encouraged take it. However, here as in many companies, training tended to be more focused on the time when a new application was implemented, which meant that employees hired after the introduction of the training received only minimal assistance: “Like they, on the site here, they brought a whole load of computers and set up a training room and put groups and groups of people through. ... But by the time I came in it's kind of like rather diluted and it was pretty tough to find somebody who knew what you wanted to know. So, there is some not unreasonable accessibility to training stuff.” (#144)

Access to technology was a problem for a small number of users. Some, mostly the plant operations people, had only shared access to technology at work. Thus, they had to compete for access to a computer where they could do their work or engage in learning activities. Others found that their lack of a computer (or access to company software systems) at home, when they might be able to work on learning, was a barrier.

Time was a particularly difficult problem. It was mentioned by the greatest number of users (12 times). It relates to personal motivation, company values and the pace of change. Respondents felt they had to make a choice between doing their job and learning new things,
implying a focus on the short term while sacrificing the long term. Yet if management placed more value on learning IT skills then perhaps the time would be found: “I guess if there's any discomfort it's the competition for time between doing your job and learning new things - I don't think you get any sympathy for not doing your job because you're doing training” (#378). The first part of the quote demonstrates the competition for attention, while the second statement demonstrates that the company values performance today more than learning for tomorrow.

Other users recalled situations where they had been booked to attend training, but were not able to do so due to a lack of time. Other priorities had cropped up at the last minute, or colleagues had not been able to cover the load, and the training had to be postponed (or forgone altogether). Thus, the lack of slack resources in the corporate environment (this company like many others had undergone significant downsizing) result in a lack of time for activities other than those that produce direct and immediate results. Learning new technologies or enhancing technology skills suffers as a result.

One respondent, a process operator who had previously been an administrative assistant, provided an interesting counter-point to this view: “At times [time was a barrier to learning], but at times it was a real push. 'Cause when it hits the fan and stuff has got to be out and you'd never worked that package before. Boy you learn in a hurry I'll tell you. That can be a little benefit. But other times you have to do maybe less than your best because of the time constraint just to get it out the door. And then fix it later” (#176). Thus, she recognized that lack of time could hinder her learning but she also realized that there were times when lack of time promoted very focused learning. Two other users, both fairly low level users of IT, also expressed the view that time was not a significant barrier to their learning. Thus, we argue that time is a particular barrier for those with middle levels of skills. Those with very high skills (like the processor operator quoted above) find less of a barrier from lack of time, since their level of skills makes learning something new less challenging. Those with very low skills will require more structured and formal means of developing skills where time is more easily managed. The biggest challenge exists for users with moderate skills, since these users are trying to learn as they go, through informal means, where work pressures can more easily compete with learning activities.

Looking within cases, we counted the number of barriers mentioned by each user, and evaluated the degree of concern expressed by the users about these barriers. The analysis suggests that four users perceived low, four perceived low-moderate barriers, four perceived moderate barriers and seven perceived moderate to high barriers. Generally speaking, the users with high degrees of capability expressed fewer and less serious barriers to their learning. Users with moderate and lower capability generally expressed more and more serious barriers. This is consistent with a view that barriers to learning hinder the translation of a felt need for updating into the development of new skills.

Additional Findings

In addition to the elements of the model we identified, our results suggest other aspects may be important. These interact with elements of the model or with related constructs.

Roles of Technology. As we discussed technology with the users, several different views of this technology, or the different roles that this technology played, emerged in their answers. The most prevalent role of technology was that of a workhorse, where technology is viewed as a tool or resource that matter-of-factly performs a large number of tasks with dutiful execution. The next role of technology expressed in the interviews was that of a roadblock, where technology could be an overwhelming barrier or block to conducting work or gaining competence. Technology as a roadblock was a letdown or disappointment.
These first roles of technology, as a workhorse or a roadblock, were the most prevalent views and expressed many times. Three other roles were expressed by a few people but seemed to capture elements important to building competence. The first of these infrequently expressed roles was that of technology as a magical tool, a powerful sense of technology as magically creating its work that is not knowable to the user. Another infrequently expressed role of technology was that of a plaything, or belief that technology is there to be enjoyed in play and that this enhances competence by exposing new perspectives and creating a comfort level. And finally, the last infrequently expressed role of technology was that of a source of interest, where technology is seen as a reason to venture out and seek information.

These roles of technology seemed to dictate how users looked to technology in the conduct of their jobs and as they built their skills. For example, if technology was only seen as a workhorse, then it was expected to perform its tasks dutifully but not considered highly for building or expanding skills and capability. It was a workhorse not a source of new ideas. These roles of technology almost defined how users reached out for and employed technology.

**Learning and Performance.** The tension between when to learn and when to conduct the work is constant, and, given today’s competitive environment, users are struggling to find this balance between workload and learning. As noted earlier, time the biggest barrier to resolving this balance, but since they have no free time, difficult choices are made.

I'm always looking for the easiest way to do it and sometimes the easiest way is using a computer program but I think-do I have to learn that to make it easy-aw, to hell with it I won't bother with it. So, basically, I know I'm wrong --I don't spend the upfront time to save time later. I don't make that investment. So, that's my own stupidity if you like. (#427)

**Goal Orientation.** Part of this balance between performance and IT learning is the type of goal orientation held by individuals. Whether individuals held performance orientation (demonstrating) or learning orientation (developing) at the fore influenced the way they engaged tasks and built skills. This orientation set a general tone between the preference for demonstrating competence where users were quick to dismiss learning activities and focus on getting the job done to the detriment of their longer term skill development, and developing competence where users were quick to dismiss job pressures and seek out the “right” learning to the detriment of work performance. Learning, performance and goal orientation are interwoven.

**External Management Processes.** ChemCo had, over time, developed an annual review process that required individuals to set goals and work towards them. This management by objectives process was their way of attempting to encourage employee self-management. Interestingly, however, we found that rather than using the process to manage their learning, the respondents managed the process.

Interviewer: Have you ever not met one of your goals? 258: No.  
Interviewer: So in the 2 years you’ve been here you’ve achieved them all? What do think it would be like if you didn't? 258: Wouldn't happen.  
Interviewer: Wouldn't happen, you just wouldn't let that happen? 258: But if you didn't do it then obviously it wouldn't be good. You sort of...what's our rule of thumb here...underestimate, over deliver. It's the [ed] model. You never state what you can't do...ever. (#258)

So, they did not include in their MBO plans anything they felt they might not get to. As a result, rather than encouraging self-management, the process became a bureaucratic exercise which many found frustrating rather than helpful.
Conclusions

The model put forth in this paper is consistent with, and extends, the traditional view of IT training (e.g., Compeau et al. 1995; Nelson et al. 1995). It is also relatively simple. But our findings suggest that it is not simplistic. The way in which this process unfolds is more dynamic and complex than the literature would suggest. This model represents a more complete understanding of the development of UC, a process where motivators and drivers interact with an individual’s self-assessment, creating a “felt need for updating” of IT skills. This “felt need” is determined by the user in response to instrumental drivers (task demands, job/role demands, technological demands) as well as personal interest and maintenance or development of an acceptable self-image (image/identity). It is influenced by how one defines competence (in relation to tasks, peers, or technology potential) and it changes depending on how one assesses the fit between the required skills and one’s current skills. A “felt need” may, in turn, lead to updating activities; however, various barriers and deterrents have the potential to sidetrack the developmental process. Highlighted in this understanding are complexities that are not yet clearly understood, such as the complicated process that leads to a “felt need to update” even when the pressures of increasing both work and learning demands are clearly at cross purposes. These insights provide a deeper look at the formation of UC.

For organizations, this developmental process has important implications. Implementing self-management is harder than expected and more than an organization may desire. Self-management policies may have different consequences than are perhaps intended by the organization - for instance, users only promising what they can deliver. This process also relates to work on developing a learning culture – not simply something you announce and expect to happen.

References


Hurley, B., and Cunningham, I. "Imbibing a new way of learning," Personnel Management (25:3) 1993, pp 42-


Munro, M., Huff, S., Marcolin, B., and Compeau, D. "Understanding and measuring user competence.," Information & Management (33) 1997, pp 46-57.


**Figure 1. Model of User Competence Development**
**Table 1. Interviewee Jobs and Competence Levels**

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Job Title/Description</th>
<th>Competence Group – Breadth and Depth Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>004</td>
<td>Administrative Assistant</td>
<td>High, High</td>
</tr>
<tr>
<td>006</td>
<td>Environment/Training Coordinator</td>
<td>Low, Low</td>
</tr>
<tr>
<td>019</td>
<td>Process Engineer, Modeler</td>
<td>High, High</td>
</tr>
<tr>
<td>089</td>
<td></td>
<td>Low, High</td>
</tr>
<tr>
<td>090</td>
<td>Electrical designer, contractor</td>
<td>High, High</td>
</tr>
<tr>
<td>144</td>
<td>Technical team leader</td>
<td>High, High</td>
</tr>
<tr>
<td>176</td>
<td>Process operator, former administrative assistant</td>
<td>High, High</td>
</tr>
<tr>
<td>177</td>
<td>Materials flow employee</td>
<td>Low, High</td>
</tr>
<tr>
<td>193</td>
<td>Paralegal</td>
<td>Low, Low</td>
</tr>
<tr>
<td>246</td>
<td>Administrative Assistant</td>
<td>Medium, Low</td>
</tr>
<tr>
<td>258</td>
<td>Transportation and Distribution Analyst</td>
<td>High, High</td>
</tr>
<tr>
<td>341</td>
<td>Occupational Health Coordinator (Nurse)</td>
<td>Low, Low</td>
</tr>
<tr>
<td>378</td>
<td>Project Coordinator</td>
<td>Medium, Medium</td>
</tr>
<tr>
<td>387</td>
<td>Systems Analyst</td>
<td>High, High</td>
</tr>
<tr>
<td>390</td>
<td>Maintenance Electrician</td>
<td>High, High</td>
</tr>
<tr>
<td>396</td>
<td>SAP Materials Management Analyst (IS)</td>
<td>High, High</td>
</tr>
<tr>
<td>419</td>
<td>Energy Manager</td>
<td>High, High</td>
</tr>
<tr>
<td>427</td>
<td>Plan Support Engineering</td>
<td>Medium, Medium</td>
</tr>
<tr>
<td>440</td>
<td>Design Engineer</td>
<td>Low, Low</td>
</tr>
</tbody>
</table>

**Table 2. Barriers to Learning**

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Number of Times Mentioned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training/Support Related</td>
<td></td>
</tr>
<tr>
<td>Lack of Training Provided</td>
<td>5</td>
</tr>
<tr>
<td>No Access to Learning Materials (i.e., manuals)</td>
<td>5</td>
</tr>
<tr>
<td>Poor Support</td>
<td>3</td>
</tr>
<tr>
<td>Distractions in Learning Environment</td>
<td>2</td>
</tr>
<tr>
<td>Training Approaches</td>
<td>1</td>
</tr>
<tr>
<td>Technology/Access</td>
<td></td>
</tr>
<tr>
<td>Access to Technology at Home</td>
<td>2</td>
</tr>
<tr>
<td>Access to Technology at Work</td>
<td>4</td>
</tr>
<tr>
<td>Technology Quality</td>
<td>2</td>
</tr>
<tr>
<td>Related to Company</td>
<td></td>
</tr>
<tr>
<td>Company Lack of Value of Skills</td>
<td>6</td>
</tr>
<tr>
<td>Related to Time</td>
<td></td>
</tr>
<tr>
<td>Time – absence of slack resources</td>
<td>12</td>
</tr>
<tr>
<td>No Opportunity to Explore</td>
<td>2</td>
</tr>
<tr>
<td>Pace of Change</td>
<td>4</td>
</tr>
</tbody>
</table>