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**Mental Capital and Wellbeing:
Making the most of ourselves in the 21st century**

**State-of-Science Review: SR-C5
The Impact of New Technology in the Workplace on Mental Wellbeing**

Michael P. O'Driscoll and Elizabeth C. O'Driscoll
Department of Psychology, University of Waikato, New Zealand

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Summary

There is now substantial evidence that the development and implementation of new technologies in the workplace may improve organisational efficiency, productivity and effectiveness. In recent years the psycho-social implications of these developments have also attracted attention from social scientists. Specifically, there have been growing concerns over the potentially negative effects of rapid technological change for individual mental health and psychological wellbeing. For example, recent research has illustrated that, under certain conditions, extensive usage of information and communication technology (ICT) in the workplace may have deleterious impacts on the wellbeing of individual users, as well as having broader social consequences for family and community social functioning. To date, however, these research findings have had little direct bearing on policy formulation regarding technological developments. Rather, the latter have been driven predominantly by economic and technological 'imperatives'. This report summarises major research findings on the relationship between new technologies and individual mental health and wellbeing, and articulates some key issues to consider in the implementation of future technological developments.

1. Introduction

New technologies are continually being introduced into organisations and society in general, and the rate of technological change is escalating rapidly. Mamaghani (2006), for instance, has noted that, prior to the 1990s, the utilisation of advanced technology was typically limited to manufacturing and production companies, with much lower rates of utilisation in the non-production sector (such as offices). During the 1990s, however, and into the 21st century, there has been an explosion of technological change globally, particularly in computer-based and other media technologies. These are often referred to collectively as information and communication technology (ICT), whose increased sophistication and power has generated significant benefits for individual workers and organisations.

ICT has had a dramatic impact on the way in which work is performed, as well as providing greater access to information and more interactive communication mechanisms (e.g. via the internet). Many commentators have noted that continued advances in ICT will reduce the need for traditional office settings, resulting in a more mobile workforce and increased use of telecommuting, which can have positive benefits for individuals endeavouring to balance work and family responsibilities (see the review by Westman in this series). These advances will also benefit organisations by maintaining a more flexible workforce which is able to respond more effectively to changing demands generated by globalisation of the business environment. These benefits have been well documented (Mamaghani, 2006).

There is also clear evidence that greater percentages of workers are now using, and reliant upon, ICT to perform their jobs (as well as for non-work activities), compared to their counterparts 20 years ago. For example, Gustafsson et al. (2003) reported that approximately one-third of the Swedish working population spent 50% or more of their work time using a computer, and around 80% of the Swedish population had access to cellphones and similar devices. In the USA, Lazar and his colleagues (Lazar et al., no date) presented figures from a 2001 survey indicating that 57% of workers used a computer in their work. Similar usage rates have also been reported in other countries, illustrating that the use of ICT at work is pervasive.

Despite these trends, and the obvious advantages (for both individuals and organisations) of these technologies, serious concerns have been voiced about the potentially damaging impact that ICT usage can exert upon the wellbeing of individual workers. These concerns have generated an upsurge of empirical

research on the negative outcomes of rapid technological change on individuals, a phenomenon which has been labeled 'techno-stress' (Thomee et al., 2007).

In this review we summarise recent research on the effects of advanced technology on mental health and wellbeing, consider some of the factors which may 'moderate' negative effects, and suggest some possible strategies for dealing constructively with technological changes so that positive outcomes are accentuated and negative impacts are reduced. Our primary focus is on computer-based technology, as this represents the major direction of technological change in the 21st century, but parallel issues apply to other technologies.

We conclude with some tentative suggestions for future research and the development of strategies which would balance the continuing need for technological development with the psychological health and welfare of individuals and society.

2. New technology and wellbeing

As noted above, there is considerable evidence that ICT and related technologies can have both positive and negative implications for the mental health and wellbeing of users. Our intention here is not to provide an exhaustive review of the literature, but rather to focus on some key factors relevant to technology usage.

Adopting a socio-psychological perspective, outcomes of technology use can be grouped into three broad categories: cognitive, affective and behavioural. Although these three categories are clearly interrelated and interdependent, most research attention has been given to affective (emotional) outcomes of technology use. Positive affective outcomes, which arise when individuals are able to use technology effectively to achieve their goals, include feelings of self-efficacy and mastery, a sense of goal achievement, and feelings of greater efficiency and effectiveness at work. Negative outcomes include experiences which typically relate to anxiety concerning one's ability to effectively use the technology, frustration due to problems or limitations in the technology which block goal attainment, depression arising from long-term perceived inability to cope with advanced technology, plus perceptions of job insecurity due to technological change, and general negative mood states.

In addition, there is accumulating evidence that, despite its capacity to enhance communication between people in work settings, in reality ICT can have the opposite effect: reducing meaningful social interaction between individuals, even within the same work organisation, and hence creating feelings of social 'isolation' (Gustafsson et al., 2003).

2.1. *Mastery and self-efficacy*

We discuss these two factors together, as they are closely interrelated and have the same impact on attitudes toward, and usage of, new technology. Several studies have demonstrated that perceptions of mastery (or control) and feelings of self-efficacy (in relation to use of technology) relate positively to technology attitudes and behaviours. In a study of communication technology workers who might be expected to have favourable attitudes toward, and considerable experience with, ICT, Beas and Salanova (2006) found that feelings of competence (self-efficacy) in relation to computer usage were significantly linked with reduced burnout (both emotional exhaustion and cynicism) and less anxiety and depression.

In addition, their findings supported the notion that perceived control over technology will moderate (buffer) the relationship between computer training and burnout. That is, consistent with Karasek's (1979) job demands-control model of work design, individuals who felt greater control were more likely to benefit from training designed to increase their ICT skills.

Similar findings have been reported in other studies. Beckers and Schmidt (2003) observed that feelings of control over the technology led to more positive experiences and greater liking for this technology. Bessiere et al. (2006) also found that self-efficacy plays an important role in predicting positive outcomes of computer usage, while Compeau et al. (1999) noted that high self-efficacy is related to expectations of positive outcomes from technology usage, positive affective reactions, reduced anxiety, and greater likelihood of computer usage.

The above (and other) research suggests that feeling mastery and control over technology can have significantly positive effects for psychological wellbeing, most notably resulting in less anxiety (over ICT usage) and depression (arising from failure to master the technology). This important finding has significant implications for the design of training programmes and other activities to increase individuals' knowledge and skills, and enhance their overall wellbeing. Early identification of lack of computer self-efficacy is essential to enhance ICT skills and usage, as well as for the design and implementation of future technologies.

2.2. *Anxiety*

Numerous empirical studies have focused on levels of anxiety that people experience in adopting and utilising ICT. Anxiety may be caused by various factors, ranging from feelings of inadequacy through to concerns that one's job may be threatened by the introduction of new technology. In relation to the latter, for instance, Vieitez et al. (2001) observed a significant relationship between workers' perceptions that technological innovation would lead to job insecurity and possibly loss of job opportunities, as well as their psychological wellbeing, including anxiety and depression. This finding confirms previous research supporting the perceived link between technological change and job insecurity.

Other studies have focused more on the actual usage of new technologies, and those variables which can influence people's reactions to them. There is now considerable evidence that anxiety arising from doubts about one's ability to cope with the demands of ICT can affect not only an individual's motivation to adopt (or continue to use) ICT, but also their actual usage and their mental wellbeing. For example, Beckers and Schmidt (2001) demonstrated that computer anxiety is a multi-dimensional construct which incorporates knowledge of computers and how they function, physical arousal caused by ICT, beliefs about the benefits of computer usage, and a person's affective (emotional) feelings about using computers. In a later study, these researchers found that experience using computers, especially when that experience is positive, mitigated feelings of anxiety (Beckers and Schmidt, 2003).

Similar findings have been obtained by other investigators. Czaja et al. (2006) recently reported that computer anxiety can exert a powerful effect on people's motivation to use ICT, and that the relationship between age and adoption of computer technology (which is typically found to be negative) was moderated by computer anxiety. On a more positive note, it is evident that levels of anxiety concerning ICT usage can be alleviated by appropriate training, effective support from others in the organisation (including IT personnel) and positive experiences using the technology.

One quite specific component of ICT is the internet, which has become an increasingly utilised source of information acquisition and communication, and is a significant dimension of ICT in work environments. Again, as with other areas of ICT, anxiety has been found to be a significant factor in internet usage. A recently published study by Joiner et al. (2007) illustrated a significant negative relationship between internet anxiety and internet use. That is, individuals who reported anxiety about such issues as not being able to understand internet terminology, not knowing how to conduct searches on the internet, and general fear of internet 'breakdowns', were more likely to not even attempt to use the internet. Such anxiety can

have a paralysing effect on a person's motivation and skill in utilising this technology, as well as impeding their work performance, which in turn would affect their overall sense of wellbeing.

2.3. Frustration

Alongside anxiety, frustration is also a commonly-reported phenomenon in research on reactions to ICT and other technologies. A high proportion of ICT users seem to report momentary, and sometimes persistent, feelings of frustration with this technology, and this sense of frustration can have a deleterious impact on their psychological health and wellbeing. A comprehensive model of computer frustration has been developed by Bessiere et al. (2006) who argue that frustration with technology can arise in various ways, although typically these are linked with an inability to achieve one's goals in a timely fashion (see also Lazar et al., no date). Bessiere et al. (2006) noted that frustration may increase a person's arousal level and that, while a certain amount of arousal leads to optimal performance, excessive arousal can be debilitating in terms of both performance and wellbeing.

Other researchers have identified the major sources of frustration in computer usage. These include time lost due to unclear error messages, unpredictable delays in programme reaction times, poorly designed interfaces that may be difficult to comprehend and utilise, unduly long download times, features that are difficult to identify and locate, and lost connections (Ceaparu et al., 2004). There is accumulating evidence that user frustration has a substantial impact on both work productivity and workers' emotional states.

In summary, anxiety and frustration can be serious obstacles to effective use of technology, as well as impacting on a person's psychological wellbeing. Unsurprisingly, it has been noted that frustration with technology can lead to user avoidance. However, with the current proliferation of ICT (and other related technologies), it may be impossible for many workers to avoid exposure to this technology. Continued frustration and anxiety may create feelings of impotence and mood reduction, which clearly will influence an overall sense of wellbeing, including depression in the longer term.

3. Training

Much has been said about the need for training so that people can master new technologies. In addition, it has frequently been noted that training programmes and efforts do not always result in effective learning and behaviour change. There are several potential reasons for this. First, the training provided may not be attuned to the needs and capabilities of trainees. For instance, it has been demonstrated that older workers may have less facility to learn computer-based skills, may need slower-paced learning, and may experience greater anxiety and concerns about using technology to perform tasks that previously they carried out in some other manner (e.g. manually).

Furthermore, training may have varied outcomes for different people, and hence it is important to consider individual differences in (for example) perceptions of technology, self-efficacy, and what has been referred to as the 'digital divide' that separates those who can use ICT (and other technologies) from those who cannot (Bessiere et al., 2006; Czaja et al., 2006). In this respect, it is critical to examine those factors which moderate the relationship between technological demands and individuals' experiences (cognitive and affective).

Specifically, the experience of anxiety, frustration and lack of control over the technology, along with how individuals endeavour to cope with these experiences, may exert a substantial influence on both their ability to perform adequately and their psychological wellbeing (Beckers and Schmidt, 2003; Bessiere et al., 2006; Joiner et al., 2007). Training experiences need to be tailored to accommodate these individual and dispositional factors.

A further consideration that has been borne out in research is that effective learning is self-paced, that is, that people vary in the speed with which they can assimilate new skills and knowledge. This is particularly significant in developing ICT-based competencies. Opportunities need to be provided for individuals to acquire and fine-tune their technological knowledge and skills at a self-defined pace, rather than via a pre-packaged training programme that takes no account of individual differences in speed of acquisition of new skills.

Finally under this rubric, given the increased rate of technological change, and an acknowledgement that specific skills and knowledge may quickly become outdated and inapplicable in a new technological environment, it is critical that workers have the opportunity to acquire competencies and knowledge that are generalisable and transferable to other contexts. At its core, effective learning entails the development of mastery, which includes a perception of personal control over one's environment. Numerous studies have illustrated that perceived lack of control exerts a major influence on variables such as dissatisfaction with the job, work alienation, psychological strain and burnout, as well as affecting how individuals react to changes in their immediate environment, both at work and in the non-work domain. Development of a sense of control is critical to psychological health and mental wellbeing (Beaudry and Pinsonneault, 2005; Salanova et al., 2002).

4. Conclusions and recommendations

As many commentators and researchers point out, technological change is inevitable in our societies, and it is likely that the rate of change will continue to escalate, so that the technologies available in the future will require fundamentally different skills and knowledge from those that exist today. Changes in technology within work organisations are predominantly driven by:

- a) The 'technological imperative', which assumes that the development of new technologies is inherently good and essential;
- b) Economic factors in the global environment, which require organisations to continually enhance their functioning in order to be competitive, and such enhancement is typically of a technological nature.

The mandate of social scientists, therefore, is to conduct research to enhance our understanding of the relationship between people and technology, and to assist with the development of socio-technological approaches to the management of technological change.

5. Suggestions for future research

Clearly, more empirical research is required on the long-term impact of ICT and other new technologies on the mental health and wellbeing of individual workers and society more generally. Significant efforts have been made in this regard, but there is a need for more longitudinal, programmatic research that focuses on a wide range of outcomes of relevance to both individuals and their organisations. In addition, such research should explore cross-national similarities and trends, to enable the development of pan-cultural socio-psychological approaches to technological change.

6. Practical initiatives

As noted earlier, some key socio-psychological factors need to be considered in adopting and implementing future technologies within organisations. To date, little consideration has been given to these factors (Mamaghani, 2006), mainly because the major focus has been on advancing the technology *per se* rather

than on its impact on individual workers. Research has clearly illustrated the criticality of factors such as mastery (control) and self-efficacy, and more attention must be given to the enhancement of these psychological states.

The provision of appropriate training, learning experiences and support will be vital to ensuring that workers of the future can manage technological change, and that their health and wellbeing are enhanced rather than impeded by technology. This training, learning and support needs to be tailored to the specific needs of individuals, and must ensure that the competencies acquired are generalisable and transferable to other tasks and settings.

Finally, much has been said about the need for 'user-friendly' technology, but technological interfaces are frequently designed with little understanding or acknowledgement of human functioning and capability (Bessiere et al., 2006; Ceaparu et al., 2004), and how demands on cognitive processing will affect an individual's ability to cope. Technology design, development and implementation require an understanding of how individuals think, feel and react when dealing with systems which may require new skills, throw up new challenges to their modes of operating, and may not be totally under the individual's control, especially when malfunctions occur.

7. Job insecurity

One issue that we have not dwelt upon in this review is the potential for job insecurity that technological changes may create. As illustrated above, new technology may have a considerable impact on individual users. In addition, it may lead to a need for fewer personnel in an organisation, resulting in organisational downsizing, which in itself will have significant consequences (financially and psychologically) for workers. These consequences are most severely felt by individuals (and their families) whose jobs have been terminated, but even 'survivors' (people remaining in the organisation) exhibit reactions that may negatively impact upon their wellbeing (Mantler et al., 2005).

8. Teamwork in organisations

Nor are the effects of technology limited to individuals. In many organisations, teamwork has now become 'virtual', via video-link and computer-based interactions. Given that the focus of this report is on individual wellbeing, we have not explored the impact of technological changes on the welfare of teams in organisations, but there is abundant evidence that these changes have a substantial bearing on team functioning and processes, which also influence individual wellbeing (see, for example, Marshall et al., 2007). These effects are also important to consider when reviewing the relationship between workplace technological changes and worker wellbeing.

9. Conclusion

Organisations and individual workers will benefit if more attention is given to the socio-psychological aspects of technological change, and to increasing our understanding of the factors that promote greater 'fit' between technology and people's needs, attitudes and capacities. Development of effective processes for designing, implementing and evaluating the impact of technological change is critical for enhancing not just productivity but also individual mental health and wellbeing.

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