

HOW DATACAPTURE WILL BE AFFECTED WORLDWIDE BY ERGONOMIC CONSIDERATIONS

This interest has been fuelled by media-publicised court cases, heart-rending human interest stories and new evidence of causal relationships between alleged medical complaints and working methods and environments. New medical words have become common vocabulary in the workplace - tenosynovitis, carpal tunnel syndrome, tendonitis, epicondylitis - and public and government concern has been generated throughout the world.

The purpose of this paper is to provide an objective management overview and hopefully allay some of the more irrational concerns.

Firstly, there is nothing fundamentally new. Tenosynovitis for example was first recognised in the 19th century when clerical workers who had to write perfectly formed copperplate handwriting developed writers cramp. Assembly-line workers in the auto industry, poultry packers, bricklayers, painters and decorators and people in most repetitive or high-speed production line style of occupations are prone to repetitive strain problems and/or injuries (RSI).

What is new is that the proliferation of computer terminals in offices has brought the problems to public attention. In particular, in Europe between September and December 1988, 24 cases of RSI were reported among journalists on the Financial Times. In the western world nothing is more widely publicised than issues which effect people working in the media.

Within a very short time, newspapers and the courts were full of RSI cases - mainly of people working with word processors but also some data entry professionals. Public concern triggered research, analysis and government legislation. This paper looks at two aspects - ergonomics and the European legislation on use of visual display terminals.

The Ergonomics Overview

The aim of ergonomics is to understand the relationship between the human being, his/her occupation and the environment in which he or she works. Knowledge of ergonomics is used to create equipment, jobs and working environments so that human beings can operate as effectively and safely as possible.

The key aspects of work to which ergonomic principles apply are:

1. The equipment to be used.
2. The environment in which the work takes place.
3. The job and work organisation.

1 Equipment

Within the ergonomic design of a piece of equipment, probably the most important issue is the "human-machine" interface, the two major components of which are:

(a) the perception of the display of information - which should allow the operator to be able to read the display quickly and unambiguously;

(b) the manual operation of controls - including the layout of the various controls in relation to the operator as well as the relation to each other; the use of colour, textures and types can all help the operator to use the controls quickly and accurately.

Anthropometric Considerations

Anthropometrics is the study of the human body size, shape and strength. There are two types of anthropometric data available:

(a) Structural (Static) - This data relates to measurements such as height, weight and the dimensions of the various component parts;

(b) Dynamic (Functional) - This data relates to measurements of human movement, such as arm reach, load lifting capacity, etc. Comparative data are available for different groupings: male/female, adult/child, nationality and occupational groups, etc. The data includes both the average measurements as well as the range of variations that may exist.

Example: average height of UK adult males is 5ft 7ins; but 90% of the sample population is in the range of 5ft 3ins - 6ft.

This data can be used to specify such dimensions as desk or table height, thigh-to-desk clearance, seat-to-desk distance for different kinds of workers in different working positions.

2 Environmental Issues

Three major factors that may adversely affect health, performance and comfort, in an office type environment, are:

- a) **Noise**
Noise is defined as "unwanted sound"; it has three primary effects:
- (i) damage to hearing;
 - (ii) interference with performance;
 - (iii) creation of annoyance.



Michael Aldrich

Public interest in workplace ergonomics in the context of the use of automated IT equipment in the office is a relatively recent phenomenon.

The level of noise, and the duration of exposure together can produce very marked effects. For example, sound in excess of 130dBs will cause acute hearing damage, while sounds at 150dBs (eg an explosion) will rupture the eardrums. Prolonged exposure to noise in excess of 80dBs (eg an unshrouded printer) can damage hearing permanently.

Noise below 80dBs is unlikely to damage hearing, but it may affect performance in one of two ways:

(i) Masking - this is background noise that makes it difficult to hear important sounds, such as alarms, instructions, etc;

(ii) Annoyance - when the noise is a distraction and may affect the operative's concentration.

As a general guide, noise should not exceed 65dBs in a workshop, or 40dBs in an office. The best way to tackle the noise problem is at source, by either removal or by screening.

b) Lighting

Visual perception depends on the relationship between three different factors:

- (i) the overall level of illumination in the environment;
- (ii) the size of the object being viewed;
- (iii) the degree of contrast between the object being viewed and its background.

Inadequate, or inappropriate lighting for a task can lead to errors being made as well as to visual discomfort and fatigue.

Of particular concern are:

(i) Flicker

Flicker may lead to the stroboscopic effect, and may affect the small number (around 0.08%) of epileptic sufferers who have what is known as 'Photosensitive Epilepsy', and who should never be allowed to use VDUs.

(ii) Glare

There are two types of glare:

Disability Glare - which interferes directly with the visual performance, and is the more serious;

Discomfort Glare - which is irritating and distracting, leading to fatigue.

Glare can be avoided by appropriate siting of equipment relative to the light source, maintaining a uniform level of lighting, using matt surfaces and by screening.

c) Thermal Considerations

These relate to temperature, humidity and ventilation, any of which can cause problems.

(i) Temperature

The temperature range in which humans can operate comfortably is actually quite small, between 20C and 26C. People engaged in sedentary occupations will be comfortable at higher temperatures than those engaged in strenuous activities.

Overheating can lead to drowsiness and lack of energy with adverse effects on performance and an increased likelihood of errors. Overcooling leads to restlessness with reduced concentration and alertness which will affect the performance of mental tasks. Temperatures below 16C lead to numbness and stiffness in the fingers and therefore have a significant effect on manual dexterity. It is to be noted that 16C is the lowest temperature allowed for persons engaged in non-strenuous work under the UK Factories Act 1961 and the UK Offices, Shops and Railway Premises Act 1963.

(ii) Humidity & Ventilation

Relative Humidity (RH) levels of between 30% and 70% are easily tolerable, but RH levels of 40-50% are preferable to prevent uncomfortable drying of the mucus membranes. Ventilation is necessary in an enclosed environment to maintain the correct balance of respiratory gases and to remove odours, smoke and other irritants. As a general guide, a room needs 30 cubic metres of air per hour per person. It is also important to bear in mind, however, that changes of air include the movement of that air. Relatively small movements, as low as 0.2 metres/second, can produce irritating and uncomfortable draughts particularly noticeable by sedentary workers.

Many of the symptoms of the 'sick building syndrome' can be attributed to inadequate air conditioning, lighting, ventilation, temperature and humidity control.

3 Job and Work Organisation

Good equipment and environmental ergonomics can easily be irrelevant if work procedures and organisational structures are poor. Poor work design can lead to fatigue, boredom and stress; in turn, these factors

can lead to poor performance terms of quality and quantity, accidents, ill health, high absenteeism and staff turnover to poor staff relations through the organisation. Many of effects can be expressed in terms of financial costs.

The introduction of new technologies into the workplace often exacerbate matters removing some of the skilled interesting work from employees, leaving them with more routine and repetitive tasks to perform. However, it is possible to choose, or design, systems that have the opposite effect: allocating functions appropriately and by giving consideration to design principles. Consultation with staff before a new system is implemented is essential.

Many managers are already familiar with the principles of motivating, retraining and job development, job rotation schemes etc. These are the same principles that apply to job design the aim which is to optimise employee efficiency and satisfaction together not one at the expense of the other. Essentially, a well designed system should:

- (i) form a coherent job;
- (ii) enable the job holder to feel a sense of worth;
- (iii) provide variety of methods;
- (iv) allow feedback on performance;
- (v) entail the use of discretion in the carrying out of the work;
- (vi) carry attributable responsibility for the outcomes and particularly the control of the work.

4 Ergonomics Summary

One key role that management can play in improving ergonomics of the workplace is to understand the characteristics of the tasks and the workers within their organisations well enough to be able to specify their ergonomic requirements. This will help ensure that any application of ergonomics in the organisation whether it be the choice of equipment, layout of the workplace or the design of jobs, it will be most suitable for the situation.

The Regulatory Response

Governments in the advanced western societies have regulated health and safety in the workplace for up to 150 years by publishing from time to time regulations, laws and codes of practice. Regulation has generally been reactive responding to events that have

already happened, rather than proactive trying to foresee and prevent something undesirable happening.

Since the arrival of computers some 40 years ago there has been continuing interest from western societies in the question, "Are computers bad for your health?" Most people have discussed the question at some time, and most people have decided that the question is unanswerable because, "it all depends..."

What is clear however is that there are a considerable number of alleged medical complaints associated with office automation equipment and a list of possible causes. In some cases there are proven causal relationships and with the amount of worldwide research being undertaken other causal relationships may well be found in the future. There will always be argument about the evidence relating to specific medical complaints (see table).

And opinions may differ about whether computers are intrinsically hazardous or whether the problem lies with management, the working environment or even in

the mind. But there is no escaping the fact that people fall ill.

Hitherto, the response of governments (federal, state and city) has been to set a general framework of regulation for health and safety facilities in offices - restrooms, lighting, fire regulations,

heating, etc. but not to impose on employers a general duty to ensure the health and safety of their employees. In the past, if an employee felt that an employer had been negligent and as a result the employee had suffered injury, the employee could sue the employer.

Under emerging legislation in Europe the employer's duty to ensure the health and safety of employees is now becoming a matter of criminal law. This has been the case in the UK since 1974. Managers can go to jail for health and safety failures, and employees can still sue for damages. It is not surprising that there is a growing interest by managers in health and safety.

At the same time the legislators are casting a much wider net to stamp out what they perceive to be bad work practices in offices. Effectively the strict regulation of the workplace that has been applied to factories for many years is now being applied to offices.

In May 1990, the European Community consisting of 12 European countries, passed a new law specifically requiring all employers to meet extremely high standards of health and safety for all users of visual display terminals.

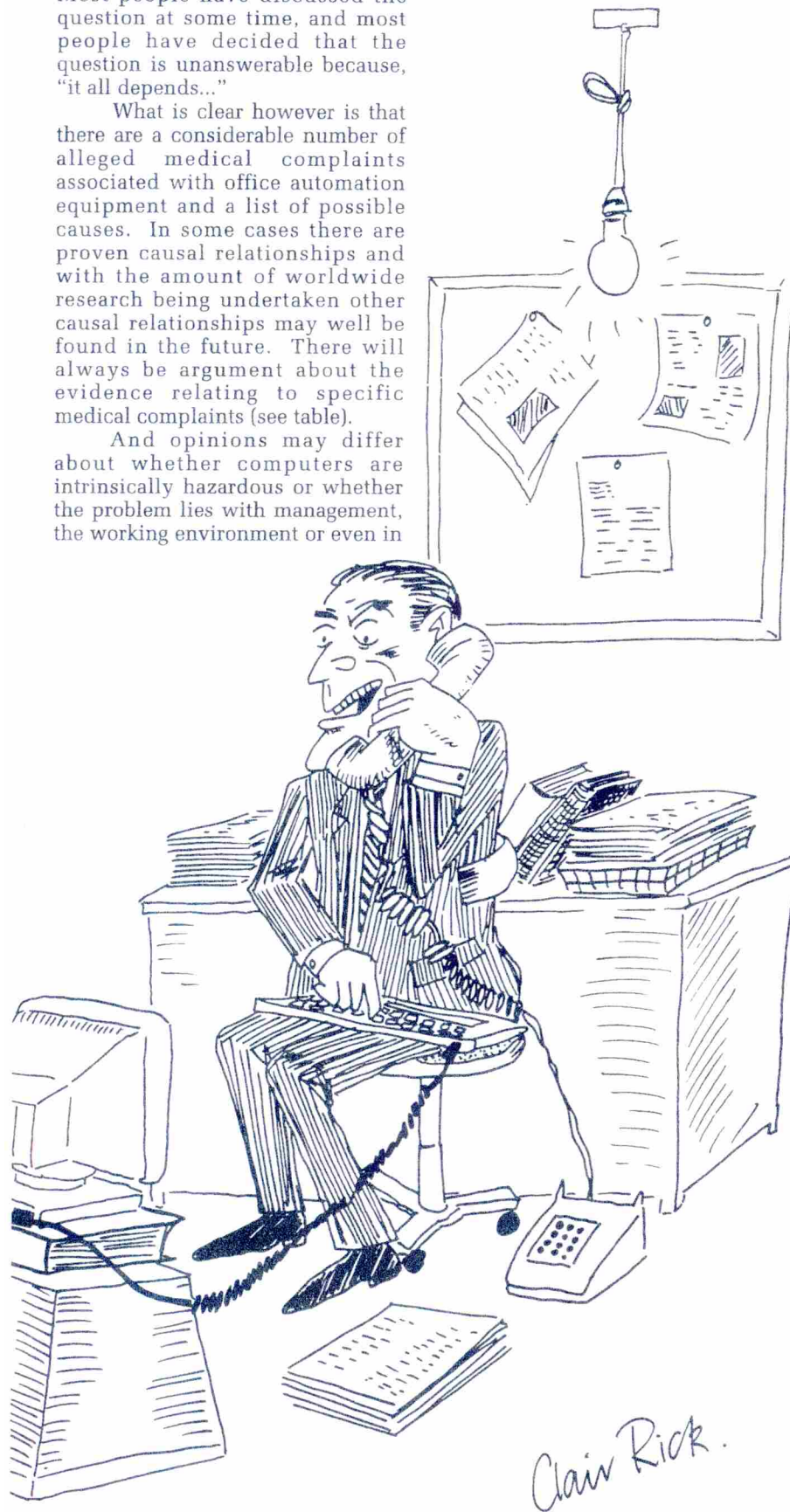
The law requires employers to ensure:

- (i) that both the screen and the keyboard are adjustable;
- (ii) that they are separate from each other;
- (iii) that new detailed standards for seating, desks and lighting are met;
- (iv) that employers provide regular breaks;
- (v) that employers provide regular eyetests for employees and pay for glasses should they prove necessary;
- (vi) that employees are adequately trained in the proper use of the equipment

The primary reason for the new law is to halt the increase among employees of repetitive strain injury (RSI). RSI is the largest cause of occupational illness in the western world. The new law comes into effect on January 1, 1993.

It is a sobering thought that, from that date, managers can go to jail for not training terminal operators properly. The right of operators to sue employers for damages even if the managers have been jailed will remain.

As a result of this legislation employers have begun to look seriously at office and terminal ergonomics and training. It is already apparent that there are no pure and simple solutions to the



problems of conforming with best practice or sometimes even conforming with extreme interpretations of the law. Employers have therefore developed action programs which begin with Ergonomic Audits conducted by professionals to assess compliance with the law.

From the audit, plans are developed to change equipment, environment, work and job organisation and training to bring them into line with the law. These plans can often be far-reaching and very demanding of resources of money, management time and employee participation.

The overall concept is simple. A healthy workforce is likely to be more productive than a sick workforce. One of the differentiators between advanced societies and less advanced societies is the sensitivity to and investment in workforce health and safety. Quality and performance can only be achieved by working with people, and people work best working safely with health in mind.

Impact on Data Capture

The impact of the new legislation in the countries to which it applies will be to increase the costs of all office-based usage of keyboard terminals. Offsetting these cost increases will be improvements in quality and performance of the operating units.

Moves to capture information electronically at source will be accelerated and may become more financially attractive in comparative terms.

Within the jurisdiction, organisations must invest in new equipment, new environments and staff training. Organisations will want a return on this investment through improved quality and productivity. Old equipment will disappear rapidly.

Outside the jurisdiction, organisations will have comparative operating cost advantages but any activity that has shades of sweatshops or labour exploitation will be avoided by within-jurisdiction organisations. The possibility of a large increase in out-of-jurisdiction work transfer is probably minimal.

This article formed part of a paper given by ROCC's chairman, Michael Aldrich at the 15th DEMA (Data Entry Management Association's) Conference held on November 18th 1991 in Dallas, Texas.

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Alleged medical complaints associated with office equipment and their possible causes

GENERAL ACHES AND PAINS (eg, headaches, visual fatigue, nausea, eyestrain, bodily fatigue, neck and backaches, arm and wrist aches) - **CAUSE:** screen brilliance, character size and style; level of lighting, noise, temperature and humidity; working posture and working patterns.

STRESS (psychological and physical) - **CAUSE:** uncomfortable working position and unpleasant work patterns. NB: chronic stress can have a direct role in "producing" diseases like ulcers and aggravating other complaints like asthma. It can also aggravate psychosomatic conditions and indirectly cause problems, such as making someone smoke more and thus increase the risk of cancer.

VISION PROBLEMS - **CAUSE:** side effects of drugs like Valium and Librium are reported to lead to sore eyes. Some computer operators who wear contact lenses, bifocals or multifocals may also encounter problems.

RSI AND TENOSYNOVITIS - **CAUSE:** badly-designed keyboards; uncomfortable working posture, particularly for arms, wrists and hands. Insufficient breaks in work routine.

DAMAGE TO HEARING (including deafness and tinnitus - a ringing sound in the head) - **CAUSE:** exposure to excessive noise, such as loud printers or badly-adjusted earphones. Exposure to pervasive background noise.

CATARACTS - **CAUSE:** induced by non-ionising microwave radiation emanating from electronic equipment, especially monitors.

PHOTOSENSITIVE EPILEPSY - **CAUSE:** exposure to flickering monitor screen may trigger fits in someone already suffering this condition.

FACIAL DERMITITIS (including occasional itches to substantial rashes and eczema) - **CAUSE:** static electricity fields and radiation emissions in vicinity of monitor cause or aggravate pre-existing skin complaints.

CANCERS (various types) - **CAUSE:** contact with noxious chemicals in laser toner. Exposure to ultraviolet, infra-red, X-ray, RF and microwave radiation across the electromagnetic spectrum.

MISCARRIAGES AND ABNORMAL BIRTHS - **CAUSE:** ionising radiation coming from, and posture and stress problems associated with, working with monitors.

MALE REPRODUCTIVE PROBLEMS (including loss of libido, sterility and testicular damage) - **CAUSE:** exposure to microwave and other non-ionising forms of electromagnetic radiation.

ELECTRIC SHOCKS (including electrocution and injuries caused by resulting falls, etc) - **CAUSE:** poor wiring, overloaded sockets and/or build-up of static.

SPRAINED AND BROKEN LIMBS - **CAUSE:** tripping over badly-organised electrical and electronic (eg LAN) cabling.

BURNS - **CAUSE:** electrical short circuits, over-heated equipment and fires - caused by printout paper etc. being ignited whether as a result of discarded cigarettes or over-heated equipment.

THE RESPONSIVE WORKSTATION

FROM ROCC

As the subject of ergonomics in the workplace should be very much on the minds of companies over the ensuing years, so ROCC has already taken positive steps to help its clients by releasing the Responsive Workstation, a piece of office furniture designed so that it adapts to suit individual members of staff through its unique height adjustable surface, giving maximum comfort in use.

Its principal features encapsulate a variety of worksurface sizes; easy height adjustment from 52 to 80cm; full cable management; low reflecting worksurface and integral modesty panel.

The simple design is built to last with a structure of steel frames which are allied to laminated tops. These are resistant to burns and scratches and are easy to clean.

No matter how complex, a calculator can only do sums, whereas a computer can solve problems.

Worksurface height is one of the most critical factors in the ergonomic design of a workstation and to comply with the forthcoming EC legislation a height adjustable desk will be essential. Furthermore, as job sharing and job rotation become more commonplace, companies with height adjustable desks in conjunction with adjustable chairs already in situ or on their shopping lists means that their staff will be able to use the same workstation instead of continually hunting around for a comfortable desk and chair.

Workers establish their working position in relation to the worksurface. As every person is a different height, the relationship between their arms and a keyboard or desktop will almost certainly be wrong on a fixed height desk, even if their chair is adjusted correctly.

To achieve the ideal sitting and working position, the chair should be adjusted in height so that the upper legs are parallel with the

floor and the back and lower torso are supported. A fixed height desk may then be too low or too high in relation to the elbow for keyboard usage. If the worksurface height is wrong, then an incorrect posture will be adopted.

Using these facilities, Local Authorities can set standards for care and service.

With these two factors working in unison the person is then in a correct working posture. If this is right then the risk of work-related problems like repetitive strain injury, muscle fatigue, shoulders and back pain are greatly reduced. Substantial court and out of court settlements have already been paid to employees for strain injuries caused in the workplace and made headline news. Additionally, companies are having to find extra funding to supplement their salary overheads in respect of hiring temporary staff to cover for those employees who are absent from the workplace due to repetitive strain injuries.

Keyboard ergonomists favour eliminating palm rests from keyboards so if an operator is to have the correct arm/wrist position it is imperative that the desktop or keyboard height is right and this can only be achieved with a height adjustable desk.

The cable management of the Responsive Workstation meets BS6396:1990, the British Standard specification for electrical systems in office furniture.

As the use of moulded plugs and sockets is increasing so the cable management allows for their easy insertion and removal inside the large horizontal and vertical cable ducts. These have separate channels for power and communication cables. All the wires, plugs and sockets are hidden yet can be quickly and easily accessed.

To complement the Responsive Workstation a full range of accessories are available including footrests, document holders, uprighters and storage

units, together with a choice of seating with matching or coordinating fabrics which conform to the strict ergonomic and aesthetic requirements of modern business. The chairs feature lumbar support and are fully adjustable from the seated position for backrest height and rake and for seat height adjustment.

For further information on the Responsive Workstation and its accessories, please contact Alan Springford, divisional director marketing, at ROCC's Crawley headquarters or telephone him on 0293 531211.

Extract from the Financial Times, Tuesday, December 17 1991 headed 'Interest awarded in test case on repetitive strain injury - Keyboard operators win damages from BT'. The opening paragraph reads 'BT was yesterday ordered to pay damages and costs to two former keyboard operators who suffered repetitive strain injury (RSI) in a test case which could have widespread consequences throughout industry.'

Paragraph 3 'They were awarded £6000 damages each for pain and suffering, plus £660 interest. The court has yet to decide how much should be paid to the women in compensation for loss of earnings. BT was ordered to pay costs estimated at £100,000.'

Paragraph 5 reads 'Judge Byrt ruled at a county court in the City of London yesterday that BT, formerly British Telecom, had failed to provide adequate desks and chairs for the women and had failed to ensure correct posture.'

An important point was raised in paragraph 10. 'Employers have traditionally not paid employers' liability insurance premiums for clerical staff and no reserves have been set up for them.'

The editorial concludes by saying 'Insurers specialising in employers' liability policies are increasingly conscious of the risk, especially in relation to white-collar staff.'

Companies need to be aware of the implications if they fail to comply with the new legislation.