Ergonomics in the absence of training or supervision – making products safer globally

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ABSTRACT

Adult consumers – and many professionals – are expected to be able to use almost all the products they buy without supervision or training. Many of those products will pose residual hazards that are not necessarily obvious and may be ineffective or sub-optimal for their task if used erroneously. Only a few products can be designed to be completely intuitive and totally benign or fail-safe. Whether products are used safely and successfully depends not only on the variability of individual users and their environment but also on the effectiveness of the instructions and warnings prepared and supplied by the manufacturer. Shaping product instructions to meet users' needs and capabilities is an ergonomics concern just as much as shaping seating, control panels or organisational structures.

What constitutes good practice in the preparation and presentation of product instructions became clear from research in ergonomics and related disciplines before the end of the last century, but the application of these practices across jurisdictions and product manufacturing sectors (particularly in smaller scale businesses and low-price consumer products) has been poor in the absence of an internationally accepted standard. Achieving this has required engaging with other stakeholders within the unfamiliar structures and processes of the international standards bodies – persistently over several years.

The message here is that for human factors research and experience to have a positive influence on product safety and usability at a global scale, ergonomists need to engage with other professionals in ways and environments outside the scope of usual ergonomics career paths or job descriptions.

KEYWORDS

instructions, warnings, product safety, standards

Introduction

Ergonomics case studies commonly have a narrow focus: on one task, one product, one type of accident, one workplace, one transport service or perhaps one whole organisation. The human factors issues are identified and measures implemented within months. This paper has a broader focus and timescale: the process of institutionalising ergonomics measures within thousands of organisations to reduce the risks of error by untrained users of products in unsupervised settings.

It describes the long haul to normalise (across industry sectors and legal jurisdictions) ergonomics insights into the presentation and effectiveness of instructional material for users. The goal is for the independent assessment of product instructions to become as routine as testing their physical properties against the relevant technical standards. For an individual product, the expected reduction in risk of injuries or complaints is likely to be modest. However, aggregated world- and sector-wide the potential benefits in safety and satisfaction of users should far exceed what could be achieved by an ergonomist advising an individual company on its instruction presentation.

Many products pose residual hazards that are not necessarily obvious, while others may be ineffective for their task if used erroneously. Adult consumers (and many professionals) are, however, expected to use almost all the products they buy without the assistance of any trainer or supervisor. This means they must rely solely on the instructions and warnings presented with the product to understand the residual hazards and what protective actions to take.

Relying on individual human product assemblers and operators outside any of organisational structure should always be the risk prevention measure of last resort (compared to designing out the hazard or designing in protective devices) due to the disappointing research findings for product instructions being noticed, read and followed. Nevertheless, this situation remains unavoidable currently for many categories of consumer and professional products.

The Problem

There is legislation in most developed economies requiring instructions and warnings to accompany products when a need for them is foreseeable. Moreover, they must be taken into account by courts when judging the whether the safety of a product is adequate - in order to decide issues of prosecution, recall or civil liability. However, such legal requirements are generally expressed at a rather general or abstract level. No warnings or instructions can ever be expected to be 100% effective in preventing accidents, so it is open to argument in individual cases as to what wording and form of presentation is adequate or reasonable for untrained users to expect.

Comparing a range of publications offering guidance on the preparation and presentation of product instructions and warnings, there has been a fair degree of consensus on what constitutes good practice since the 1980s. This has been available in the form of commercially published books (Schoff, 1984; Austin, 1985; Inaba 2004) and informal guidance documents put out by standards or government bodies responsible for product safety (BSI, 1984; Cooper & Page/HMSO, 1988; CPSC, 2003). Furthermore, much of the advice is supported by evidence from research studies by ergonomists or psychologists (eg Szlichcinski, 1984; Laughery, 1994; Page, 1997; Wright, 1999).

The two major global standards bodies (IEC for electrical standards, ISO for most others) first step towards codifying good practice in this field was “ISO-IEC Guide 37”, which had appeared in 1973. This focussed on instructions for consumer products, but it was just one of a series of guides aimed at members of standards drafting committees and was not written in a way that conformity with it could be made a requirement in individual product standards. A quarter of a century passed before IEC published the first attempt at international standard: IEC 62079 in 2001. Although this converted many of Guide 37’s recommendations into normative requirements (in the language of standards turning “should”s into “shall”s), it did not specify procedures for assessing overall conformity. Its scope was not limited to consumer products, but a question mark hung over whether (as a standard drafted solely by IEC) it was legitimate for it to include non-electrical products within its scope.

In everyday life there continued to be plenty of evidence of failure to apply established good practice: consumers surveys repeatedly found the same common complaints levied at product instructions generally – particularly poor translations and confusing illustrations (DTI 1998, Wimmer 2003, Fraser 2007, Richardson 2007, Straub & Fritz 2009). Meanwhile, absent warnings, misleading illustrations, poorly translated instructions and text that is too small (see figure 1) or too low contrast to be noticed or easily read have been common causal factors in product-related injuries (Wogalter, 2019).

Figure 1 Example of safety critical instruction hidden in small print

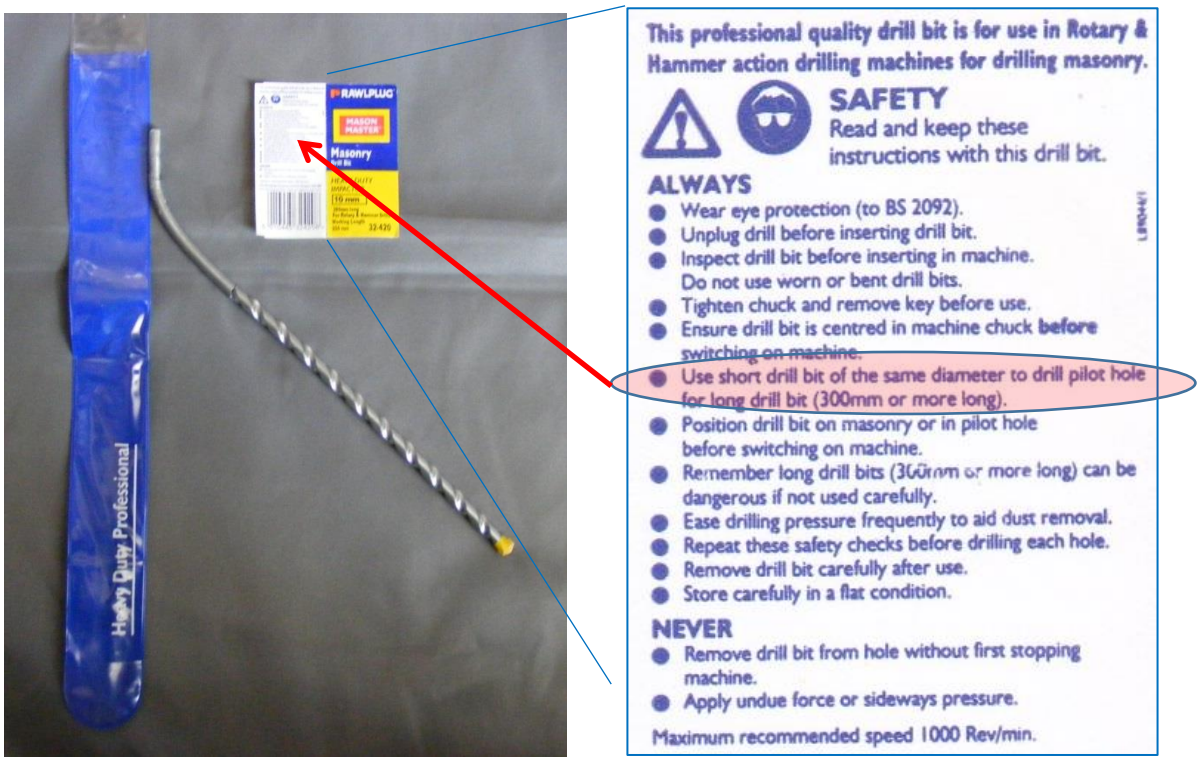

Figure 2 Table of recommended text sizes in 82079-1 standard

Analysis

What has still to be achieved is a high degree of awareness and application of good practice across product manufacturing sectors - particularly among smaller scale businesses and low-price products where instructions are more likely to be prepared in-house by staff involved in design of the product rather than out-sourced to a technical communication specialist (or ergonomist) approaching the product more like a new user.

By the mid-2000s it had become clear to ergonomists such as myself -and other user representatives involved in product safety - that what was needed was a single internationally accepted standard for the presentation and process of preparing instructions which should include requirements that make it possible for all the information (documents, labels or other media) accompanying a product to be independently assessed – in parallel with the testing of the product's compliance with whichever technical standards set requirements for its physical properties.

The justification for a single instructions standard being applicable across all types of product is a basic ergonomics one: the common element is not any feature of the product that the instructions support – or the medium in which they are presented – but rather that the intended users to whom any instructions need to be addressed all share human sensory and information processing limitations and a potential for misunderstanding and error.

The reason to aim for an international standard is that non-perishable products are increasingly packaged for potential sale in a wide range of jurisdictions with the effect that instructions are often produced to a single presentational design with multiple translations of the text. Additionally, if an adequate international standard exists, the risk of conflicting national (or industry sector) standards being created is usually pre-empted.

However, the organisational structures did not make this easy. The world of international standards is a labyrinth of committees - structured by industry sector – composed largely of experts in the design and physical testing of equipment. This makes it easy to sub-divide areas of responsibility but difficult to establish a trans-sectoral project (drawing on expertise in human communication) in such a way that a wide range of manufacturing industries will accept that it applies to their products.

The long haul to a solution

It was somewhat serendipitous that as a BSI consumer representative (then working on a new edition of Guide 37) I became aware of the 62079 standard and was able to get myself appointed as a BSI representative to the obscure committee to which IEC charged its revision. It was also fortunate that the members of this "Maintenance Team 21" welcomed my proposal to invite the participation of ISO. Thus a routine revision developed into a project to develop a new joint standard, "82079", covering all aspects of information for use of products in a series of parts under a joint working group. Unfortunately, the 'co-parent' committee ISO chose was not TC10 (ergonomics) – as I had hoped – but TC10 (which is mainly concerned with technical drawings). Nevertheless, they were supportive of the project and appointed me as their co-convenor of the joint working group.

Part 1 of 82079 was first published in 2012 (see reference BSI, 2012). It made general requirements applying to instructions for products of all types, replacing IEC 62079 and addressing a number of the previously raised criticisms. In particular, it gave recommendations for the minimum size of text and symbols in the form of a grid, which took into account: viewing distance, purpose, font and contrast with background (see figure 2). It also set requirements for the presentation of instructions in electronic media to ensure that this increased accessibility to more users, rather than introducing new barriers. More controversially, it introduced a requirement that claims of compliance with the

standard must be supported by evidence of the information media having been evaluated by suitable experts who had not previously been involved in that product's development.

However, as the 2012 standard came to the attention of a wider range of interested parties, further concerns were raised about its practical application in certain industry sectors. The joint working group therefore soon commenced a further revision, this time with the additional participation of the IEEE (a US engineering institution and standards body). The current edition of 82079-1 was therefore published (in 2019) under the logos of all three standards bodies. It was adopted as the current British and European Standard in 2020. (See reference BSI, 2020)

IEEE had particularly wanted to make the requirements relevant to the instructions for use of software as well as physical products. The revision explains the advantages and disadvantages of all the options for supplying various aspects of information for use: as a single product manual or folded sheet, by labelling on packaging or the product itself, and in printable files, videos, or searchable databases accessed through accompanying software or a website.

To address the needs of the international body representing instruction writing services (ISTC) the revised standard provides an option for a technical communication business to be assessed as conforming with the standard in respect of its processes and competences - which is likely to become an advantage or condition for firms tendering for contracts to produce comprehensive manuals for large industrial products.

However, consumer representatives insisted that any claim of conformity with the standard when marketing consumer goods be based on an assessment of the information supporting a particular product against the standard's requirements for content and an empirical effectiveness check (eg involving a panel of target users).

Also at the insistence of consumer representatives the revision include some basic requirements specific to the presentation and evaluation of self- assembly instructions for products supplied as kits to untrained users. [It is envisaged that Part 2 of 82079 will more detailed recommendations on representing instructions for self-assembly products through illustrations and I recently prepared an initial draft for this - again drawing heavily on human factors research.]

The 82079 joint standard series is applicable on its own to the instructions for use of any consumer or industrial product. However, having been designated as a 'Horizontal' standard it is also intended to be referenced in product-specific standards such as IEC 60335 (for all parts for household electrical products), ISO 20607 for machinery, and ISO/IEC 26514 for systems and software.

Under both UK and EU legislation BS EN 82079 is a relevant voluntary standard that is required to be taken into consideration when assessing whether a consumer product meets the "General Product Safety Requirement" Similarly it may be quoted as representing a consensus of expert opinion on what users are entitled to expect of instructions and warnings in civil product liability claims.

The current edition is showing signs of broad acceptance as awareness is being spread through articles and textbooks in the technical communication and product safety professions (Vermeulen 2019, Fleischer 2020, Lewis 2020). Meanwhile the UK national consumer product safety authority (OPSS) has begun to investigate the extent of conformity with the standard among products currently on the market (BEIS 2020).

Transferrable lessons/learning

Ergonomists need to be more involved in the work of drafting standards wherever safety depends on influencing human awareness and behaviour. This is particularly important in standards for products with residual hazards that are used without supervision or prior training.

While ergonomists are obviously needed on standards committees focussed on ergonomics practice (ie within ISO TC 159) they are likely to have most impact (ultimately) where they are the only human factors professionals closeted within a standards committee or working group composed mainly other areas of expertise and commercial interests. This is where they can bring to other stakeholders' attention published research in ergonomics (and associated scientific disciplines) indicating the most effective practices for reducing user errors and accidents.

International standards may take time and persistent involvement through their evolution from proposal to publishing and delays can be expected before new (or revised) standards requirements are widely used in some sectors (and legal jurisdictions). However, their eventual reach can be expected to have more impact than national or regional requirements as standardised goods are increasingly made to be marketed across the globe.

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