BEHAVIOUR & INFORMATION TECHNOLOGY, 2001, VOL. 20, NO. 5, 299–305

A personal view

AHMET E. CAKIR

c/o Ergonomic Institute, Soldauer Platz 3, D-14055 Berlin, Germany; e-mail: ahmet.cakir@ergonomic.de

Abstract. In the 20 years from its first issue, BIT has been active in an area of technology with fast and thorough changes. After scanning through 20 volumes, I am surprised to detect that the published scope of BIT has remained almost unchanged, and many statements in the first editorial could be published today without replacing a single word. BIT did not give up its basic principles published in the first issue, e.g. the '*intention to show that academic rigour need not be sacrificed in order to achieve relevance and practicality*' although in the two decades of its life span not only one of the biggest empires of all time collapsed but also an unprecedented change in technology was to be witnessed. The makers of BIT, i.e. its editors, authors and referees, did not limit their role to witnessing the change passively.

The papers of the past 20 years focused on applications and their usability rather than on treating issues related to bits and bytes (technical technologies) or discussing social issues related to technology. For the next 20 years, we may try to deal also with more practical issues arising from the emergence of electronic media fully emancipated from paper. It took about 20 000 years to develop graphic art and 500 to cultivate typography—why not help to establish the art and technology of electronic communication in a much shorter time?

1. Introduction

BIT has become 20 years old—time to have a close look at the balance sheets. Nine colleagues from the original crew whose names appeared in the first issue in 1982 are still active participants. What of the topics mentioned in that issue as focal points of interest for this journal? How many problems can be considered solved after 20 years?

Tom Stewart stated in his first editorial, 'our ability to handle, store and communicate information is advancing at an enormous pace. Much of the real impact has yet to be seen. Despite all the advances over the past two decades, most of the change lies ahead of us, not behind'. Who would argue against including this statement in the editorial of the 20th Anniversary *BIT* issue?

There was another important development mentioned in the first issue: 'This [advance propelled by the silicon-chip technology] has encouraged the convergence of three hitherto distinct industries: computing, telecommunications and office equipment'. How many editors of contemporary magazines would refuse to print such a sentence in an article on future developments?

My question concerns the impact that *BIT* (and the authors and publishers of it) has been able to exert on the development of 'information technology', from legibility of displayed information to changing the structure of organizations. Have we managed to contribute anything meaningful to the change or has our role been limited to accompanying the development and reporting about it? As General Editor, I would like to include all contributors to the quality of our journal into 'we'; this means not only the Editorial Board and the authors, but also the large corona of reviewers who perform an excellent job without being named anywhere in literature.

2. 'Information Technology'

2.1. *'Technology': ambiguity par excellence*

Since most of us have never been involved in designing chips or cables, and *BIT* has almost never published articles focusing on bits and bytes, it would be questionable whether such a journal could contribute to 'technology' at all. As the core part of any article, we seldom treat topics such as mobile database transaction models; data distribution, replication, caching and synchronization; or recovery and fault tolerance. What has been our role in the development of technology during the past two decades?

The word 'technology' is well known and often used, but it is ambiguous to a higher extent than most of the

Behaviour & Information Technology
ISSN 0144-929X print/ISSN 1362-3001 online © 2001 Taylor & Francis Ltd
http://www.tandf.co.uk/journals
DOI: 10.1080/01449290110078699

words we know. While most ambiguous words possess two different meanings where one of them is more common than the other, technology is used in three different meanings with all having vital importance for human life, regardless of the involvement of persons, groups or organizations with them. The problem for *BIT* and other journals interested in human and social behaviour is the lack of clear borders between the three meanings. In addition, English usage scarcely reflects the direct translation of the original Greek word '*techne*', the term 'technique', which serves to express simple technical solutions. The word 'technology' represents the following three termini technici:

- technical technologies,
- intellectual technologies,
- social technologies.

A method for using movable type for printing is an example for a technical technology; refining sand to store data in silicon-chips is another good example. Technical technologies may pass away without having any important impact on human life regardless of the brilliance of the idea behind them, e.g. the 'Wankel motor'. The first two cases above, however, may be considered two of the biggest contributions to changing human life on earth.

As can be seen from the history of Gutenberg's invention, technical technologies need clever applications to become 'intellectual'. An example for this is the newspaper, in ancient Rome called *Acta Diurna* ('Daily Events'), a daily gazette dating from 59 BC and attributed in origin to Julius Caesar. The daily gazette, compiled from the news of the previous 24 hours, restarted its career as an intellectual technology about a century after the invention of the technical technology of printing. The Venetian republic set a precedent by charging an admission fee of one 'gazeta' to public readings of the latest news concerning the war with Turkey (1563), thus recognizing a commercial demand for news, even on the part of the illiterate. The term gazette was to become common among later newspapers sold commercially.

Unfortunately, most people in the world have not been able to read books or newspapers until recently. Most of them received the news, if ever, through the newssheet, which was not printed but handwritten by official scribes and read aloud by town criers. The same was true for rules and laws, which the normal public would not read but hear. The way European rulers have changed this situation in the 19th century demonstrates how one can use technical technology to create social technology: forcing people by law to visit schools, supplied with cheaply printed books. The technology that has defeated illiteracy comprised all levels of technical and intellectual technologies, from paper and ink production to book printing, that were utilized to achieve the social goal to be met, i.e. that not a single subject or underling of the king should be able to claim not to have heard the law.

To which 'technology' did we contribute? A precise answer to this question may help us detect the correct path to the next two decades, where the world will meet another big challenge related to a more modern form of illiteracy.

2.2. *'Information': ambiguity as a class of its own*

The ambiguity of the word 'information' seems to be much simpler than that of 'technology'; however, the implications of it are much worse. The reason is that 'information' as used by almost all people has two extremely different meanings. Literature mostly does not include any definition of the term 'information', except for some authors who cite the so-called 'Information Theory' of Shannon and Weaver. The problem is that this theory is related to data transmission and was originally called 'Communication Theory'. Properly applied, it yields the quantity of data transmitted from a sender to a receiver in bits—i.e. in an objective measure—while 'information' is purely subjective: 'The meaning that a human assigns to data by means of the conventions used in their representation' (ISO 2382 1974). The key to comprehending the entity called information technology lies in understanding both meanings of information—the subjective and the objective—and not using a mixture. (In later issues of ISO 2382, the term information was redefined so as better to reflect common misunderstanding. For this reason, I avoid citing them.) For people involved with technical technologies, the focus lies on the objective meaning of the word information, while others need to decide where their focus is on a scale from 'fully objective' to 'entirely subjective'.

If people complain about their workplace being flooded with information on the one hand, and about the lack of information on the other, they mean that they receive irrelevant data with no meaning for them while they are looking for other data that would make sense for them. The incompatibility of these two feelings was resolved some thousands of years ago by the philosophy of early sophists. Protagoras expressed this fundamental idea in his famous dictum 'man is the measure of all things'—meaning that for a particular person her/his own perception of reality is important rather than reality itself, but the sophists never argued

that there was no reality. How successful can a journal be if it tries to link human and organizational behaviour with a subject that can be understood in 2×3 ways?

3. The harvest

3.1. *Contribution to technology in general*

From my personal experience, *BIT* has contributed to technology mostly in the sense of 'intellectual' technology. In other words, we did not focus on technical technologies such as physics of more usable electronic displays. Neither did we try to promote such things as new non-volatile storage media instead of semiconductor memories (static RAM and especially dynamic RAM), which might have been able to add more to user comfort or to overall usability of computers than the topics we have dealt with. Likewise, we did not try to focus on 'mega trends' associated with information technology, i.e. social changes initiated, caused, accelerated or sometimes inhibited at least partly by the use or non-use of technology.

For 16 years the published scope of the journal remained unchanged, although the area in which we have been active was not only marked by revolutionary change but also partly needed to be reborn, e.g. the term usability was coined as a *terminus technicus* during this period. The development related to subject areas of *BIT* such as 'ergonomics' and 'dialogue design' has paved the way to a new area of engineering called 'usability engineering', which hopefully will form the most important part of software engineering. Forming a whole branch of engineering from an idea that started life simply as 'ease-of-use' is an achievement we can be proud of. Moreover, many authors, reviewers and members of the editorial board of *BIT* were among the creators of it.

Usability is related to interaction with technical systems and aims at helping to improve effectiveness and efficiency of use. Through improving user satisfaction in addition, usability represents a powerful means for converting computer applications and systems into media that change human abilities in forming, presenting and transporting data that other humans may consider information in the real sense of the word. Twenty years after the first issue, some revolutionary changes may look less significant than they are in reality, e.g. the difference between 'electronic mail' (as in the first editorial) and 'e-mail' as we call it today. One can learn to appreciate the real difference by visiting remote places where people learn to communicate with the rest of the world somewhat more easily than we learned to hold a fountain pen properly some decades ago. Any doubts about the importance of usability for technical development are easily forgotten after studying the effects of the 'usability' release that one of the major software companies introduced last year (SAP R/3, release 4.6). By promoting usability, *BIT* has contributed to forming 'social' technologies.

The contribution of *BIT* to technology is not limited to publishing papers. Working for this journal also encouraged some colleagues and myself to join the makers of ISO 9241 in 1983. Since then, a rather small group of people have created the most elaborate normative framework for human–system interaction, which was later supplemented by an international standard on human-centred design. Four persons of the first editorial board of *BIT* have been involved in this work from the very beginning—as chairman and convenor of working groups. In the Editorial Board list of the last issue of *BIT* there is an additional contributor to ISO 9241. In addition, in each software-related part of ISO 9241 the list of references includes at least one *BIT* paper.

3.2. *Impact for the practice*

What I intend to express in this section is strongly limited to German corporations, but I think it may also be true for companies in other countries. My experience stems from seminars on 'software ergonomics' for people from the real working world held since 1986 and analyses of software and applications our institute has performed on companies since 1990. For about five years, I was a consultant to a parliamentary commission responsible for selecting and introducing computer and communication systems in offices of Members of Parliament, which gave me different insights about the behaviour of people related to usability and its importance for work.

In contrast to popular topics such as 'radiation' emissions from VDTs (and currently from mobile phones), which many users search for in news media, usability is deemed to be interesting only for other people. For example, a congress on the EEC Directive 90/270/EEC and its implications for software offered by a health and safety organization for EDP managers some years ago had to be cancelled although participation was free. There were no delegates!

In 1991, our institute was able to convince a vendor who supplied 1300 companies with software and computer power to 'face-lift' its major application, i.e. to apply current knowledge in software ergonomics to create a graphical interface for a mainframe database. Despite the fact that this effort created enormous positive effects for all people involved—including the

vendor, from users to top management of user organizations—most companies are still reluctant to spend time and money on systematic work to improve usability. In my opinion, most existing applications in practice are 'scrap metal straight from the factory' as a German colleague described them some years ago. In his opinion, many new applications are outdated before they are launched. In my experience, most companies I know run systems that inhibit human performance instead of supporting it. Moreover, many 'systems' are not systems at all, but bits and pieces of incompatible applications. The ease with which usability experts can find systematic errors, sometimes without even looking for them, shows that they have never been analysed properly. In cases where we have been able to intervene, applying just parts of the knowledge available in HCI journals and books helped to improve the situation considerably.

Among numerous factors responsible for this situation, at least two seem to fall within our remit.

- We do not speak the language of the makers of commercial applications.
- Our notion of 'software' or 'system' does not match that of practitioners.

The first problem was brought home to me recently by a colleague whom I had asked a while ago to modernize some chapters of his book on software development by applying the relevant parts of ISO 9241. After doing so, he stated that the language of the standards was not understood by software developers. My experience with practitioners is that the language of journals like *BIT* is even less understood. To be honest, I do not know how we can change this situation without abandoning important principles of the journal ('It is our intention to show that academic rigour need not be sacrificed in order to achieve relevance and practicality...'*Behaviour & Information Technology* 1982), but it is worthwhile thinking about solutions.

The second problem—the discrepancy between the perceived reality and the actual circumstances—seems to be common to all academic and technical disciplines involved in the IT business, but not limited to them. The horizons of people who create technical systems normally reach not far beyond finalizing the product and maintaining it for a while. For example, the engineers who planned the NIKE anti-aircraft missile system shortly after World War II never thought that their grandsons would operate those missiles in the year 2001. Their task was almost finished when the rockets were deployed in the 1950s. Almost the same is true for the most common life cycle model for computer systems (waterfall), which starts with a small box named 'analyse requirements' and, after five boxes, ends with another box of the same size and shape labelled 'operation and maintenance'. In real life, the last box (maintenance) causes about 80% of all costs. Since bits and bytes are not subject to wear and tear, most of these 80% are costs of change.

Even if the life of a computer system surprisingly ends one day, its implications may last another decade or more. For example, in the year 1990 most German insurance companies owned a 'ghost computer', which did not physically exist for at least two decades (IBM 1401). They had to emulate it on more recent machines because nobody would guarantee a fault-free migration of the data. I would not be surprised to find some still running (a simulator configuration is available via the Internet). I would also not be surprised if my unborn grandchildren need some help from me in solving some '8 + 3 problem'—a legacy of the DOS-era.

The major discrepancy between our notion of a computer system and the reality, in my view, is that our artefacts have no history and leave no legacy behind them. For example, ISO 13407 on human-centred design for interactive systems displays a straightforward procedure between identifying the need for human-centred design (first box) and the stage when the system satisfies specified user and organizational requirements (finish). Whereas for the last application we analysed, the responsibilities for the development of the system had been distributed between more than half a dozen different organizational entities. In addition, the makers of that software have been forced to share many existing applications with others, but had no more chance than a snowball in hell of convincing other parts of the company to introduce changes in the sense of their users. Thus, they have to live with the legacy of applications that are partly older than the users.

After introducing that software, new users who joined the company in the aftermath of a merger were not homogeneous because many of them had joined their former company in the course of another merger a few years ago. Before these people were really integrated into the organization, it was decided to split all users into groups with new tasks for which the software was not made. During this procedure, the unit running the networks was outsourced and the responsibility for hardware was given to another entity. This organizational unit has replaced dumb terminals, for which the system was created, by Windows NT-engines with almost no user training because training was the responsibility of the organizational unit that employed the users. (The unit

responsible for the software is not responsible for organizing the work.) This is by no means the whole story of the changes in the context of use within five years. Although it sounds rather sophisticated, I do not think that this story is an extraordinary one. To interest practitioners, we need to learn to anticipate and handle such situations.

4. Things I miss in *BIT*

4.1. *Tranquillizer pills for web designers to make the madhouse bearable*

During my time as General Editor, the World Wide Web began its successful career. Not so successful are the careers of the so-called web designers, partly because of systematic problems that could have been analysed by ergonomists and published in journals like *BIT*. However, I cannot remember having received manuscripts dealing with the common problems of web design. Neither did I gain relief from the speakers at last years IEA Congress in San Diego, who paraded many success stories but had nothing to say about taming a bronco named HTML.

Today, web design is not a technology but resembles a kind of art. However, even artistic skills do not suffice if you try to find a sleek graphic design that users will definitely not be able to destroy by simply selecting another font, background colour, magnification, browser, etc. Technology is closely related to control. To feel responsible for an artefact, the maker must be in control. In the case of web design, too many parties determine the final product, the appearance of an HTML page on screen. Ambitious designers who try to regain control of their product feel more as if they are working in a madhouse than in a professional work environment. Why not apply what we know to boosting the abilities of people to create a medium with unprecedented features?

4.2. *Typography: an occasional guest in* BIT *articles*

While writing the 'VDT Manual' many years ago, Tom Stewart and I detected something strange: some of the chapters of the manuscript had more typos than others. Some days later, we had solved the mystery: those chapters with more errors had been proof-read on the screen while the others had been printed before being proof-read. In the course of the first 20 years, *BIT* has published some articles on readability and legibility of characters and text on screen; nothing, however, has been published about the most important change in this area since Gutenberg: since about 1995 new typefaces have been developed that serve electronic communication only. All these innumerable 'digital' fonts for computers have been developed for print and not for electronic communication; computer users have to use them as best they can. For example, most computer programs on PCs are delivered with Times as the default font. Times, however, was created almost a century ago to provide a good face for printed newspapers; on electronic media, Times is no more than a crutch. Of course, it is possible to get rid of it by replacing it with another font. But nobody advises which font to select, and after some time Times will return as the default font, even without the user noticing it on some computers. When installing or restoring Microsoft programs, the existing 'Times' font is replaced by 'Times' with a different code. The difference between these two is hard to recognize until one tries to open older documents. Then the machine claims that Times was not installed.

If one especially observes more than one rule concerning good typographical design and selects the font size 10 pt for Times, the text on any screen will become almost illegible. No font foundry will advise anyone to use a font size below 12 pt on screen. Unfortunately, this size will seldom satisfy the receiver of a printed letter. On the other hand, it is not easy to find a screen that can display any font below 12 pt in size properly without zooming.

Our lack of opinion concerning the most important heritage we have ever received—the art of typography and visual communication—is easily understood reading the CD-ROM with the proceedings of IEA 2000. It displays two-column papers, completely unsuitable for screen reading, which the authors have been asked to submit in Times, a font barely readable on electronic screens, and which had to be scanned instead of using the common pdf electronic format—so removing any positive impact of the chosen font, which is really not suitable for scanned documents.

If one decides to print those documents, one will not be very satisfied, because scanned documents never yield a satisfactory printed image, especially when they are prepared in serif fonts like Times. Trying to magnify the image will also yield an unsatisfactory result because of the reduced resolution of the image.

Not much more successful in exploiting typographical knowledge have been the developers of the Rocket ebook. The characters give the impression of computer screens of the past instead of attracting the buyer by outstanding typography.

We now experience the advent of a new era in which printed matter will not matter—at least for many parts of our life. Electronic screens increasingly become the major stage for presenting data, not only the large screens on our desktop, but also those you carry in your pocket. Why not help a new era be born? I think the HCI community has the best prospects of being the frontrunner in that direction. We (especially the authors) could help *BIT* to become the frontrunner amongst 'HCI people'. The importance of the topic is demonstrated by the election of Gutenberg as the most important person of the past Millennium without anyone protesting against that decision.

4.3. *Basics of workplace design related to interaction*

Some basics of interactive systems, such as adequate size of foot pedals, were never intended to be treated by *BIT* papers. Authors were allowed to do so, but not explicitly encouraged by the editorial team. What about the issue of adequate size for visual displays? I do not remember any paper dealing with an analysis of this issue except for a report from 1992 that compared reading text on 12″ and 15″ monitors. Most ergonomists did not even realize that the 'size' of a screen is different on a Macintosh as compared with a PC. If one adds a physical display device to a Macintosh, one wins additional space to display additional text and graphics; however, adding another screen to a PC may not be at all positive for the user. A 1600×1200 pixel display on a physical device has exactly the same size as a 640×480 pixel display; however, with graphical features better left undescribed. Until the advent of Windows 98, PCs were not able to use additional screens as additional space for displaying text and graphics.

To experience the difference between a single 17″ screen and sufficient space on the desktop (in my opinion, one or two 21″ screens), one does not need more than half a day working on a document. The number of clicks on hidden windows and palettes will be more than halved, and the user sees more of what she or he gets. The gain in efficiency and effectiveness through having more space may well exceed the outcome of all other measures for improving interaction.

Another field we did not cover is input devices. Only one out of 104 references of part 9 of ISO 9241, which deals with input devices, was published in *BIT*, but seven were published in *Ergonomics*, a journal not specialized in human–computer interaction. It would be interesting to know why no author has ever sent me a manuscript on how to enhance interaction with systems by using different input devices.

5. Things I forgot to miss

5.1. *Sociology, job structure, employment, etc.*

The decade in which *BIT* was launched was the heyday of studies on the social impacts of the technology later called IT, reaching from problems related to job structure to anticipated national crises due to information and communication technology. Preceded by the famous study of Simon Nora and Alain Minc 'L'informatisation de la société' in 1978, a myriad of publications flooded the bookshelves of scientists, managers and trades union representatives. The scope of *BIT* also included related topics.

I am not very sure that we have put much emphasis on such issues. I also do not remember *BIT* papers related to nationwide or worldwide social issues. During recent years, I have also noticed that people's notions have changed worldwide. Instead of discussing potential problems caused by IT systems, many people prefer to lament not having enough new equipment. Unfortunately, many problems that were foreseen about two decades ago are now with us. Some examples of developments that had been reported in many studies as potential hazards are: structural unemployment caused by technology making some qualifications obsolete; stress caused by computer monitoring of the workplace; and the undervaluing of the qualifications of many workers parallel to growing demands for the qualifications of other workers. After reading recent studies about working conditions in so-called 'call centres', where all achievements of the past concerning humanizing work seem to be ignored, I am somewhat happy that we have not wasted too much paper and ink in this direction.

5.2. *Office automation and decision aids*

The last subjects from the scope of the journal that comes to mind are office automation and decision aids in their specific form of AI. Together with 'office communication', a third topic we had tried to establish in Germany, they have left the Premier League of interesting technologies and disappeared towards specialized circles of interested colleagues. While office automation has reached its goal, albeit not exactly as intended, AI has returned to where it came from, the research labs. The technology that would hopefully boost AI, the fifth generation computer, was put to rest some years ago without even informing interested circles about the not-so-sudden death. *BIT* and *BIT* authors did not invest much effort in these areas. I do not think they were wrong in this.

6. How much is *BIT* needed in the future?

Tom Stewart wrote that, when re-reading the first issue, he was surprised how much *BIT* was still needed. Is this really surprising for a journal active in an area where technical development is faster than anything comparable in history, a journal devoted to academic traditions that forbid answering one question without formulating two new ones? I believe that the problems of our area had already outstripped our abilities to solve them when *BIT* was first launched. Many of them are still with us. Each new application and each new user group bring with them new questions to answer. Since the Executive Editor has never intended to narrow the area of activity, it will be a miracle if *BIT* lacks work in the near future. It took about 20 000 years to develop graphic art, 500 to cultivate typography, let us see how long we need to establish the art and technology of electronic communication.