Ergonomics of Information Systems: a European View – and an Italian Pioneer

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1. Introduction

Early information technology was mainly a tool for experts. Mathematicians needed machines to help them work with logarithms, army commanders and engineers needed precision for their actions, as well as for breaking the codes used by their opponents, psychologists needed ways to test the feasibility of their models of human information processing, statisticians needed support for summarizing and understanding the results of a census. In most cases the users were professionals in developing their own methods and techniques, including the way to specify the instructions for their tools. Coding, and even building the hardware, was part of their trade.

Around 1960, computers became available for science and research and the first high level programming languages allowed to structurally develop tools: FORTRAN, ALGOL 60 (Backus et al, 1957; Nauer et al, 1960). Increasingly, most new users were not interested in the machines as such and in the way their algorithms needed to be coded in order to be efficiently run by the hardware. Programming was still a basic skill needed to specify the functionality aimed at, even when, in the 70s Operating systems like CP/M or various dialects of DOS (Hunter, 1983; Lake, 2009), and UNIX (Ritchie and Thompson, 1978) emerged. IFIP considered the growing and increasingly broadening need for education about computers as well as the use of computers in education, and organized its first World Conference on Computer Education in 1970 (Scheepmaker, 1970).

But with the operating systems, more and more tools and programs were provided, readily available and specified for application domains like text processing, data analysis and representation, as well as office automation and scheduling. Programming was no longer needed in order to perform the professional tasks of the increasing number of users. In some professions, users needed (and, consequently, managed to learn) to build macros, for which operating systems and high level programming languages provided tools.

2. Information technology growing into society

Increasingly new types of use (and new groups of users) emerged: Information and communication technology as support for education, for public services, for communication, for leisure, and in (public as well as private) transport, and buildings and household tools got smarter and more interactive, and recently technology is broadly used for maintaining social relations and social awareness. The new generation of users need not be a professional in the domain of use and cannot be expected to code or build programs, or to master interfaces that request understanding of hidden aspects of a system. For this new kind of use, systems need to adapt to the untrained user in various aspects (Vyas, 2011):

- Meaning: it should be completely clear to the user why and how to use the system;
- Emotions: users are motivated by (internal) needs as well as (externally triggered) emotions. The use of a system is often not emotionally neutral, and users want to use tools and artifacts for emotional reasons, so the system should support this, by appropriate esthetics, look, and feel;
- Action: systems will only be successfully used if they trigger and support behavior that is obvious and relevant to the user's intention;
- Attitude: users will accept and use systems (only) if these fit the culture and context of use, actual intentions and needs, and suggest they will lead to a satisfactory outcome of the interaction.

In fact, Vyas' aspects are valid already for the early period where researchers needed to use programming languages, and, later on, professionals needed to use operating systems and macros (sometimes even needed to be build or adapted). And in the case of non-professional use, usability and an acceptable user experience is a precondition.

In parallel to the history of information technology as sketched above, understanding of the need for usable systems developed, in academia as well as in industry. To a certain extent, there seems to be a difference between the two

continents that were the original core of the Western world, as well as the locations where this technology was originally developed and used.

In North America Industry seems to have taken the lead: e.g., at the first CHI conference (McDonald, 1982), 4 out of 17 Steering Committee members, and 5 out of 14 Program Committee members were employed by Universities, most of the others listed an industrial affiliation. The approach towards the design of usable systems often could be indicated, as John M. Carroll (certainly a university based scholar) seems to have stated somewhere (only anecdotic evidence available to me at this moment): "the theory is in the artifact".

In Europe, at the other hand, a large proportion of usability focused work started in university context. The first ECCE conference (Green and Van der Veer, 1982) showed a program committee where all 7 members had a University affiliation, the first INTERACT (Shackel, 1984) showed over 50% of the program committee (46) listing a University as their affiliation. The next section will focus on Europe and the initial diversity of approaches towards the design of usable systems

3. European Early History

In Europe many languages are spoken. English as a second language was increasingly used for academic as well as industrial communication and publication. However, at least till the mid-80s there seem to be a strong regional flavor in many parts of Europe regarding which faculty took the lead in research, design, and development of usable systems, as well as regarding the type of application domain considered. The current section is a personal account of what the author experienced during activities in international projects, conferences, and in international collaboration in teaching.

In the German speaking part of Europe, in fact two rather different approaches could be detected:

- A focus on the user interface: in 1983 there was a workshop on user interface management systems (UIMS: Pfaff, 1983) in Seeheim, where several foundation stones were laid. The concept of UIMS was developed into an approach to support designers in explicitly specifying the dialogue separately from the application functionality. On the other hand, a clear view was developed on the user's need for a conceptual model of the system. Finally this symposium developed a vision on a system architecture (later referred to as the "Seeheim Model") to allow for relatively platform independent design, as well as for adaptivity of the interaction to context and user characteristics.
- Two series of workshops developed that can be characterized as truly interdisciplinary:
    - the series of Interdisciplinary Workshops on Informatics and Psychology, since 1978 in Passau (Germany) and Schärding (Austria) with changing names, e.g., 1981 "Informatik und Psychologie"; 1982 "Psychology des Programmierens"; 1994 "Informatics and Psychology" (Tauber et al, 1994). The leading theme in all cases was the complimentary relation between the two disciplines of computer science and psychology, where the application domain moved from ergonomics of programming and programming languages to designing interactive systems, groupware, and business processes;
    - the series of workshops organized by a subgroup of the "Gesellschaft fur Informatik" (the German Computer Society). Since 1983 the subgroup was labeled: "Interaktive Systeme" (Hoffmann, 1988), later the official name was: "Software Ergonomie", till 2000. The proceedings of these workshops show a strong relation to the Seeheim workshop, and an increasing interdisciplinary flavor (again Psychology developing a strong influence). Ergonomic aspects of programming languages and program design were other important topics. The workshops as well as the proceedings continued to be in German, though contributions in English were increasingly accepted.

Apart from that, there was inter-university collaboration, bridging east and West Germany even in the age of the Berlin wall, in the MACINTER framework, with (mainly Psychology) scholars like Norbert Streitz and Friedhart Klix (Streitz, 1984).

In the Scandinavian part of Europe, early developments showed computer scientists and psychologists collaborating, or even moving to the other discipline, like the Danish founder of the journal Cognition, Technology & Work, Erik Hollnagel who early on focused on ergonomics and safety issues of interactive systems, a focus he shared with Jens Rasmussen

who also worked at Risø. In parallel to this type of developments, a very different view emerged (often labeled "the Scandinavian Approach"):

- Trade unions in Norway, and subsequently in Denmark and Sweden, triggered by university researchers like Pelle Ehn and Morton Kyng (Bjerknes et al., 1987) managed to work with researchers to develop a general design approach ("participatory design") where strong user-involvement during the design process as well as continuous training were key characteristics.
- The Scandinavian approach often related to a specific method for analysis and design, as well as to a focus on collaboration rather than on individual users. Activity Theory (originally mainly applied in Scandinavia and the UK) provides a qualitative analytic approach towards design and implementation (Nardi, 1995). Originally developed from Soviet psychologists like Vygotsky and Leont'ev, the Scandinavian derivative focuses on practice and the context as well as the culture of use, and ethnography is a major method to acquire understanding.

In the UK (in parallel to some kernels that strongly cooperated with the Scandinavian school) the focus on user centered design mainly started at cognitive psychology departments as well as in departments for Ergonomics.

- HUSAT (Human Sciences and Advanced Technology, an institute at Loughborough University, UK) was founded in 1970 (the same year Xerox founded PARC), but it's founder and long time usability champion Brian Shackel already published research and design ideas in 1959 (Shackel, 1959a, 1959b). This group, with a strong human factors and ergonomics flavor, continued to develop new ideas, e.g., related to the UIMS concept and to prototyping languages and tools.
- In several UK departments of applied or cognitive psychology focused on applications of cognitive theories to the design of information systems. In the 70s the group in Sheffield University worked on usability aspects of programming (Sime et al., 1973) and on mental models of complex computer systems (Moray, 1979).
- British cognitive psychologists were part of the leading scholars in the European Esprit projects AMODEUS 1 and 2 (Barnard et al., 1988; Barnard et al, 1995)

In France, the research institute INRIA was founded in 1967. Both theoretical research and applied research in the domain of Computer Science was initiated here. Sebillotte (1988) and Scapin and Pierret-Golbreich (1989) initiated here systematic views and techniques for task analysis. Psychologists like Hoc published early work on planning and psychological analysis of programming projects (Hoc, 1972; 1979). Many French cognitive scientists early on focused on the collaboration and planning in complex process control situations (Savoyant and Leplat, 1983). A large volume of early cognitive ergonomic work in French showed strong collaboration and systematic development, where publication in English was eagerly awaited by the international community of scholars

French and British researchers joined forces in several cases:

- They were among the leading scholars in the European Esprit projects AMODEUS 1 and 2 (Barnard et al., 1988; Barnard et al, 1995).
- They were the initiators (and still continue to contribute) of the Psychology of Programming Group, founded in 1987 (http://www.ppig.org/)

In the Netherlands, in the 80s the Dutch Computer Society (NGI) and the Dutch Ergonomic Society (NVvE) jointly founded a working group on human-computer interaction (Van der Veer and Lammers, 1985), that later changed into a local chapter of ACM SIGCHI, and currently exists as an independent society (http://www.chi-nederland.nl/) joining both academics and practitioners in a variety of domains, from vehicle- and driving ergonomics or home automation to visual interaction and experience design. Dutch developments, often in collaboration with both the German speaking community and British–French developments resulted in contributions to the psychology of programming languages (Van der Veer and Ottevangers, 1973), as well as to task-centered method development (Van der Veer et al, 1992).

Different developments in Spain originally were rather isolated from each other.

- In Granada, Andalusia, there was an early development in the cognitive psychology group that developed, among other directions, towards cognitive ergonomic approaches based on understanding of mental models of the users (Cañas et al, 1998).

- In Lleida (Catalonia), quite independently, Lóres Vidal founded GRIHO, a research lab for human computer interaction focusing on usability, which gradually moved focus to design for cultural heritage (Sendín et al, 2001).
- In the Bask town of San Sebastian, the computer science faculty originally specialized on operating systems, but Abascal gradually moved focus to ICT users with special needs (Arruabarrena et al, 1989).

Remarkably, only through participation in international projects and events these different Spanish groups found each other and in 1999 created AIPO (Abascal and Lorés, 2003) which later on lead to collaboration with Portuguese as well as Latin American groups.

In Italy, finally, HCI has been developed from a number of different strands:

- Faconti and Paternò have been instrumental in developing approaches towards modeling: (a) of reasoning as well as interaction specifications based on the framework of the AMODEUS project (Faconti and Fornari, 1995) and (b) of modeling task domains (Paternò, 2003).
- Bagnaro, a philosopher by education, started in 1986 with a dual professorship in Cognitive Psychology and Human-Computer Interaction, originally in Siena, later in Padua, Milano, and Alghero, where he gradually moved towards interaction design. He collaborates with numerous industries, as well as with scholars like Parlangeli, Rizzo, Marchigiani, Marti, and Mariani (Parlangeli et al, 1997; Rizzo et al, 1997).

In a separate section below we will illustrate the versatility of Bagnara's work and his influence on the European domain of human-computer interaction.

4. Cognitive Ergonomics as a European view

Gradually the European approaches and views on the analysis and design of interactive systems merged. A first milestone was the first European Conference on Cognitive Ergonomics (ECCE) in 1982 that lead to the foundation of the European Association of Cognitive Ergonomics (EACE, http://www.eace.net). From its foundation the ECCE conferences did run bi-annually, since 1987 alternating with the European meetings on Cognitive Science Approaches to Process Control (CSAPC). In 2005 the two conferences merged and ECCE became an annual conference. EACE developed into a forum of researchers with a broad spectrum of specialisms. The main common base is a research – related view, grounded in cognitive psychology and its application to curation and design. Full members of EACE are qualified scientists, PhD students in the domain join as probationer members.

The actual affiliations of the members varies between cognitive psychology departments, computer science and information sciences, industrial design and communication science, as well as industrial research departments. Some North Americans joined EACE early on and have in this way contributed and remained in touch. Europe is not an isolated island.

Apart from the annual conferences, a major activity of the association is the moderated regular mailshot service, where members may post information on relevant events, educational activities, projects, internships, and publications. The mailshot frequency is about 20 each week, thanks to EACE membership officer and logistic support since 1982, Elly Lammers.

5. Sebastiano Bagnara – Pioneer and International Team Player

Among Bagnara's early work we find both theoretical and experimental work in cognitive and environmental psychology and neuropsychology (Bagnara, 1976; Bagnara et al, 1982a; Bagnara et al, 1983; Umiltà et al, 1987; Bagnara et al, 1987a; Bagnara et al, 1988). At the same time we find also both visions on, and experimental studies applied to, work situations (ergonomics) (Bagnara et al, 1982b; Boles and Bagnara, 1986; Bagnara et al, 1987b; Bagnara et al, 1994; Bagnara and Marti, 2001). Moreover, in the same broad time span there is important work on safety and human error (Bagnara et al, 1981; Rizzo et al, 1987; Rizzo et al, 1995). This development, again, is immediately applied to the user interface (Bagnara, 1982; Bagnara and Pisano, 1980; Parlangeli et al, 1999).

Newer work shows a strong relation to his psychology based view on human learning and organizational learning (Zucchermaglio et al, 1991; Bagnara et al, 1995; Bracci et al, 2000). In his more recent work, design is the ultimate outcome of merging psychology, ergonomics, and application (Bagnara, 1990; Marti et al, 1997; Bagnara and Mattioda, 2010; Pelagalli et al, 2014). Some of his recent works show Bagnara, the philosopher (Bagnara, 1998; Bagnara and Bargigli, 2005). In the newest work we find a strong vision on theory of HCI (Bagnara and Smith, 2006; Bagnara and Pozzi, 2010).

During the whole existence of EACE he continues to contribute to the lively discussions at the conferences (Viscola, 1989; Rizzo and Bagnara, 1990; Rizzo et al, 2003; Albolino et al, 2005). He has been the president of EACE (1990-1994), conference chair for the ECCE conference (1990), CSAPC (1997) and of the 3rd European conference on Cognitive Science, ECCS (1999) as well as (co)editor of multiple proceedings of ECCE, ECCS, and CSAPC (Van der Veer et al, 1991; Van der Veer et al, 1992; Oppermann et al, 1994; Bagnara et al, 1997; Bagnara, 1999).

Looking at the list of above mentioned publications, spanning 4 decades, we may conclude he was a pioneer in the emerging domain, and continues to be an exceptionally prolific and creative scholar in the European world of cognitive ergonomics. In this respect the author lists show he is a natural team player, collaborating with many colleagues, both young and senior.

6. References

Abascal J. and Lorés J. (2003) HCI in Spain. In: M. Rauterberg et al. (Eds.) INTERACT'03. IOS Press, 1077-1078

Albolino S., Bagnara S., Bellandi T., Tartaglia R. (2005) Building a reporting and learning culture of medical failures in a healthcare system. Proceedings of ECCE 2005, Chania, Crete

Arruabarrena A., Abascal J. G. (1989) Dispositivos de comunicación. In L. Gardeazabal (Ed.): Aplicaciones del ordenador y de las nuevas tecnologías en la ayuda a personas con discapacidad. Servicio Editorial de la UPV-EHU, 103-126

Backus J.W., Beeber R. J., Best S., Goldberg R., Haibt L. M., Herrick H.L., Nelson R. A., Sayre D., Sheridan P. B., Stern H., Ziller , R. Hughes A., Nutt R. (1957) The FORTRAN Automatic Coding System. Papers presented at the February 26-28, 1957, western joint computer conference: Techniques for reliability, p.188-198. ACM Digital Library

Bagnara S. (1976) La psicologia ambientale, problemi e prospettive. Giornale italiano di psicologia 1, 49-73

Bagnara S. and Pisano E. (1980) Education and practice in ergonomics in Italy. Ergonomics 23 (8), 837-838

Bagnara S., Biocca M., Mazzonis D.G. (1981) Trends in occupational health and safety policy in Italy. International Journal of Health Services 11 (3), 431-450

Bagnara S. (1982) Error detection at visual display units. Ergonomic Aspects of Visual Display Terminals, 143-146

Bagnara S., Boles D.B, Simion F., Umiltà C. (1982a) Can an analytic/holistic dichotomy explain hemispheric asymmetries? Cortex 18 (1), 67-77

Bagnara S., Misiti R., Mazzonis D. and Rollier M. (1982b) Factors in the quality of working life – 2 case studies. Ergonomics 25 (6), 573-573

Bagnara S., Boles D.B., Simion F., Umilta C. (1983) Symmetry and similarity effects in the comparison of visual patterns. Perception & psychophysics 34 (6), 578-584

Bagnara S., Roncato S., Simion F., Umiltà C. (1987a) Different levels in processing simple geometrical figures. Perceptual and motor skills 47 (2), 511-514

Bagnara A., Rizzo A., Visciola M. (1987b) The evaluation of the decision-making human behavior within a man/automation system. Skill based automated manufacturing: proceedings of the IFAC Workshop

Bagnara S., Simion F., Tagliabue M.E., Carlo U. (1988) Comparison processes on visual mental images. Memory & cognition 16 (2), 138-146

Bagnara S. 1990) The Design of Training and Education in Automation. Design Issues, 53-70

Bagnara S., Rizzo A., Failla A. (1994) Organizational structures and distributed decision making. Le Travail Humain, 387-400

Bagnara S., Rizzo A., Parlangeli O. (1995) Learning Strategies and Organizations. Organizational Learning and Technological Change, 190-204

Bagnara S., Hollnagel E., Mariani M., Norros L. (1997) Proceedings of the 6nd conference on Cognitive Science Approaches to Process Control (CSAPC 6)

Bagnara S. (1998) Ambiente di formazione, identità culturale e professioni della comunicazione. Problemi dell'in formazione 24 (4), 544-552

Bagnara S. (Ed.) (1999) Proceedings of ECCE '99. Certosa di Pontigniano

Bagnara S., Marti P. (2001) Human work in call centers: A challenge for cognitive ergonomics. Theoretical Issues in Ergonomics Science 2 (3), 223-237

Bagnara S., Bargigli L. (2005) I misteri dei mestieri: le professioni dell'ICT in una prospettiva evolutiva. Studti Organizzativi

Bagnara S., Smith G.C. (2006) Theories and Practice in Interaction Design. Human Factors and Ergonomics Series, Erlbaum Associates Inc.

Bagnara S., Pozzi S. (2010) Individuation and Diversity: The Need for Idiographic HCI. In D. M. Haftor & A. Mirijamdottir (Eds.) Information and communication technologies, society and human beings. Hershey (NY)

Bagnara S., Mattioda M. (Eds.) (2010) Index – Un percorso di specializzazione in Interaction Design Experience. Università di Sassari

Barnard P.J., MacLean A., Wilson M.D. (1988) Navigating integrated facilities: initiating and terminating interaction sequences. Proceedings of CHI'88, ACM

Barnard P.J., Bernsen N.O., Coutaz J., Darzentas J., Faconti G., Hammond N.H., Harrision M.D., Jørgensen A.H., Löwgren J., Maclean A., May J., Young R.M. (1995) The Amodeus Project - ESPRIT Basic Research Action 7090 – Final Report. MRC Applied Psychology Unit, Cambridge UK

Bjerknes G., Ehn P., Kyng M. (1987) Computers and democracy-a Scandinavian challenge. Gower Publishing Ltd

Boles D.B., Bagnara S. (1986) Proximity Grouping and Information Processing of Visual Displays. Proceedings of the Human Factors and Ergonomics Society Annual Meeting

Bracci M., Parlangeli O., Bagnara (2000) Learning and attitude change: an interactive multimedia system for women health care promotion. Learning and attitude change: an interactive multimedia system for women health care promotion. Ricerche di Psicologia 25 (1), 79-98

Breindahl C. (2008) A Scandinavian approach to interaction design. Design Research Webzine, 2 (12)

Cañas J.J., Bajo M.T., Navarro R., Padilla F., Puerta M.D.C. (1998) Representación mental y programación de ordenadores Mental representation and computer programming. Cognitiva 1 (1), 239-255

Faconti G.P. and Paternò F. (1990) An approach to the formal specification of the components of an interaction. In Duce. D. Vandoni C. (Ed.), Proc. of Eurographics'90, Amsterdam, NL, pp. 481--494. North-Holland

Faconti G.P. and Fornari A. (1995) Syndetic Modelling and Gestural Interaction. In Stefanidis C. (Ed.), Proc. of Workshop on User Interfaces for all, Heraklion, Crete. European Research Consortium for Informatics and Mathematics (ERCIM)

Green T., van der Veer G. (eds) (1982) Cognitive Engineering. Vrije Universiteit, Amsterdam

Hoc J.M. (1972) Représentation mentale et modèles cognitifs de traitement de l'information. Le Travail Humain, 35, 17-36

Hoc J.M. (1979) Le problème de la planification dans la construction d'un programme informatique. Le Travail Humain, 42, 245-260

Hoffmann H.-J. (1988) Notizen zu Interaktiven Systemen, Heft 17. Fachgruppe Interaktive Systeme der Gesellschaft fur Informatik e.V., Germany

Hunter D. (1983) The Roots of DOS: Tim Paterson. Softalk, March 1983

Lake M. (2009) Gone but not forgotten: 10 operating systems the world left behind. Computerworld, March 25, 2009

Marti P., Rizzo A., Bagnara S., Lomagistro P., Tanzini L. (1997) From system evaluation to service redesign: a case study. Advances in human factors/ergonomics, 779-782

McDonald T. (Ed) (1982) Proceedings Human factors in computer systems. ACM

Moray N. (1979) Mental workload: Its theory and measurement. Plenum Publishing Corporation

Nardi B. (1995). Context and Consciousness: Activity Theory and Human-Computer Interaction. MIT Press

Naur P., Backus J.W. Bauer F.L., Green J., Katz, McCarthy J., Perlis A. J., Rutishauser H., Samelson K., Vauquois B., Wegstein J. H., van Wijngaarden A., Woodger M. (1960) Report on the Algorithmic Language Algol 60. Communications of the ACM, 5 (3), 299-314

Oppermann R., Bagnara S., Benyon D. (Eds.) (1994) Proceedings of the 7th European conference on cognitive ergonomics (ECCE 7). GMD, Bonn

Parlangeli O., Marchigiani E., Bagnara S. (1997) Strumenti multimediali per la formazione: incidenza del livello di usabilità dei sistemi di apprendimento. Convegno A.I.P., Capri

Parlangeli O., Marchigiani E., Bagnara S. (1999) Multimedia systems in distance education: effects of usability on learning. Interacting with computers 12 (1), 37-49

Paternò F. (2003) ConcurTaskTrees: An Engineered Notation for Task Models. The Handbook of Task Analysis for Human-Computer Interaction: 483–503.

Pelagalli M.F., Liberace P., Pozzi S., Bagnara S. (2014) User-centred design and the new TV: New paradigms in the use of TV. International Journal of Digital Television 5 (2), 169-174

Pfaff G. (1983) Proceedings of the workshop on user interface management systems. Springer-Verlag, Berlin

Ritchie, D.M., Thompson, K. (1978) The UNIX Time-Sharing System. Bell System Tech. J. 57 (6), 1905–1929

Rizzo A., Bagnara S., Visciola M. (1987) Human error detection processes. International journal of man-machine studies 27 (5), 555-570

Rizzo A., Bagnara S. (1990) Collaborative interface: a PDP approach. Proceedings of the 5th European conference on cognitive ergonomics (ECCE 5), Urbino

Rizzo A., Ferrante D., Bagnara S. (1995) Handling human error. Expertise and technology: Cognition & human-computer cooperation, 195-212

Rizzo A., Mariani M., Zenie A., Bagnara S. (1997) Designing the information Cooperative for Harmonizing, Coordinating, and Promoting Earth Observation Business Process. In G. Salvendy, M.J. Smith, & R.J. Koubek (Eds.), Design of Computing Systems: Cognitive Considerations. Amsterdam: Elsevier, pp. 741-744

Rizzo A., Parlangeli O., Bagnara S. (2003) remembering and forgetting effects in analyzing search engine list results. Proceedings of CSAPC 9. VU, Amsterdam

Savoyant A. & Leplat J. (1983) Statut et fonction des communications dans l'activité des équipes de travail. Psychologie Française, 28 (3/4), 247-253

Scapin, D. and Pierret-Golbreich C. (1989) Towards a method for Task Description: MAD. In L. Berlinguet and D. Berthelette (Eds). Work with display units 89. Elsevier, Amsterdam

Scheepmaker B. (1970) IFIP World Conference on Computer Education. IFIP, Amsterdam

Sebillotte S. (1988) Hierarchical planning as a method for task-analysis: the example of office task analysis. Behaviour and Information Technology 7 (3), 275-293

Sendín M., Lorés J., Aguiló C., Balaguer A. (2001) Un modelo interactivo ubícuo aplicado al patrimonio natural y cultural del área del Montsec. IHO series 153, 22-25

Shackel B. (1959a) Ergonomics for a computer. Design, 120, 36–39

Shackel B. (1959b) A note on panel layout for numbers of identical items. Ergonomics, 2, 247–253

Shackel B. (Ed.) (1984) Conference papers Interact'84. Elsevier Science Publishers, Amsterdam

Sime M. E., Green T. R. G. and Guest D. J. (1973) Psychological Evaluation of Two Conditional Constructions Used in Computer Languages. International Journal of Man-Machine Studies, 5 (1), 105-113

Streitz N. (1984) Cognitive Ergonomics: An Approach for the Design of User-Oriented Interactive Systems. F. Klix & H. Wandke (Eds.) Man-Computer Interaction Research (MACINTER-I), Proceedings of the First Network Seminar of the IUPsyS, 21 – 33. North-Holland Publishers

Umiltà C., Bagnara S., Simion F. (1987) Laterality effects for simple and complex geometrical figures, and nonsense patterns. Neuropsychologia 16 (1), 43-49

Van der Veer G.C., Ottevangers D.C. (1977) Problem Solving by Programming. In: Proceedings of the Digital Equipment Users Society vol. 3(1) D.E.C., Maynard, Ma. 345-351

Van der Veer G.C., Lammers E. (eds) (1985) Programmatuur naar menselijke maat - Cognitieve ergonomie van mens-computer systemen. Stichting Informatica Congressen, Amsterdam

Van der Veer G.C., Bagnara S., Kempen G.A.M. (Eds.) (1991) Cognitive ergonomics: contributions from experimental psychology. Acta Psychologica 78 (1-3)

Van der Veer G.C., Tauber M.J., Bagnara S., Antalovits M. (Eds.) (1992) Proceedings of the 6th European conference on cognitive ergonomics (ECCE 6), Balatonfűred

Viscola M., Armando A., Bagnara S. (1989) Errors while learning in flight simulators. Proceedings of the 2nd conference on Cognitive Science Approaches to Process Control (CSAPC 2)

Vyas D.M. (2011) Designing for Awareness: An Experience-focused HCI Perspective. PhD Thesis, Centre for Telematics and Information Technology University of Twente, Enschede

Zucchermaglio C., Bagnara S., Stucky S.U. (Eds.) (1991) Organizational learning and technological change. Springer