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Towards New Theoretical and Conceptual Frameworks for the Interdisciplinary Design of Information Society Technologies

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Abstract: Ambient intelligence is the seamless integration of Information Society Technologies (IST) into society at large and into every aspect of daily life. The vision is one of ISTs that are an integral part of everyday life and everyday objects such as furniture, clothes, buildings, cars, washing machines, etc., so much so that the ISTs would in effect be invisible to citizens and just a taken-for-granted aspect of any object. However, this has led to concerns about the acceptability of such a goal and raised many social issues. To deal with some of these social issues one possibility is to consider an interdisciplinary approach, where a new breed of professional would emerge, who would operate in the spaces between the social sciences on one side, and engineering and technology on the other. Much of the development of this type of interdisciplinary design however, relates to the workplace, but the scope of applications and consideration of purpose are now much wider. This paper therefore addresses the topic of the development of new conceptual and theoretical frameworks that could underlie an interdisciplinary profession of the type mentioned above, but in the context of non-workplace environments. To begin this journey towards the development of such new conceptual and theoretical frameworks, some of what has already been developed in the workplace context will be analysed. This is undertaken within the context of two general classes of IST (interactive and non-interactive) that provide a means of considering the usefulness of the existing knowledge base. Considered in the paper are sociotechnical design principles, as well as some more recent theories and concepts developed for the interdisciplinary design of advanced computer-based manufacturing technologies, and these will be briefly explained. The conclusions from the analysis are presented, along with suggestions and recommendations for further research in this domain. A new sociotechnical design principle, the Non-utility Principle, is also proposed.

Keywords: Interdisciplinary Design, Information Society Technologies, Sociotechnical Design Principles, Interfacing in Depth, Social Shaping of Technology, Non-workplace Environments

Introduction

V**ISIONS FOR THE** future development of Information and Communications Technologies (ICTs) (e.g. see Wiser (1991), Ductal et. al. (2001), Aarts and Marzano (2003)) visualise a world where computers, and the communications technologies that so often accompany them, are interwoven into fabric of the built environment. Even the natural world does not escape untouched, as sensing and monitoring devices are also envisaged to be distributed across fields, forests, lakes, the seas, and mountains. These sensors, it is expected, will provide a constant stream of information that will, for example, improve responses to natural disasters, the on-set of crop diseases, and human-made environmental contamination. Even the things that people regard as their private personal possessions, such as their clothes, jewellery, and such forth, will be imbued with computer based intelligence and communications capabilities.

Terms such as pervasive computing and ubiquitous computing are associated with these visions. Such is the pervasiveness envisaged, that the term Information Society Technologies (ISTs) is commonly used instead of Information and Communications Technologies. This reflects a widely held view that these technologies are becoming a part of society, and are an enabler of a new type of society, the Information Society.

In Europe the term Ambient Intelligence is more often used to describe this future age of ubiquitous computing. Specifically, the concept of Ambient Intelligence offers a vision of the Information Society where the emphasis is on greater user-friendliness, more efficient services support, user-empowerment, and support for human interactions (Ductal et. al., 2001). People will be surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects, and their environment will be capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way. This particular perspective is founded, at least in principle, on the notion of humans at the centre of all this technology, of the technologies serving people, of a human-centred Information Society.

Not surprisingly however all these vision, human-centred or otherwise, have led to a wide range of concerns about the acceptability of such a goal (e.g. see Kidd 2007a). The issues are wide ranging, spanning from worries about the development of a *Big*

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Brother type of society, through to concerns about over dependency upon *intelligent machines* that may have more control than is desirable. In addition, some studies point to changing behaviours within society as a result of ISTs, some of these changes being unwelcome. An example is the growing tendency of mobile telephone users, in some cultures, to display greater civil inattention, that is to say, acknowledging the existence of people around them, but not bothering to take them into account when using mobile telephones in public places (Khattab and Love 2008).

As a response to these various concerns several approaches are possible. One is to undertake retrospective studies of ISTs, discover what is psychologically or socially unacceptable or poor about them, and then to call for improvements, or to urge designers of a particular technology or product to take more account of a particular issue. The work of Khattab and Love (2008) is an example of this, as they highlight as a conclusion of their work the need for designers of mobile telephones to take into account cultural differences between nations when designing these devices.

Another approach is to involve ordinary citizens in the research, development and design processes that lead to the creation of so called intelligent everyday objects (ISTAG 2004). This approach, as presented by ISTAG, is quite radical as it advocates design by, with, and for users, seeing these groups not just as subjects for experiments, but also as a source of ideas for the development of new technologies and products.

Yet another approach would be to use knowledge from the social sciences, along with technical expertise, to design ISTs and Ambient Intelligence systems: in effect, to undertake prospective application of social science knowledge in the design of new technologies (Corbett 1985, Kidd 1988).

These three approaches are representative of various schools of thought in the social sciences, and of course, they are not mutually exclusive, and all are equally valid. Indeed, all three could be used to good effect in the design of ISTs and Ambient Intelligence systems and products.

Of these three specific methods, the one addressed further in this paper, is the latter one, this being one that seeks to design technologies in a prospective way, explicitly considering knowledge from the social sciences. Specifically addressed is an interdisciplinary perspective (Kidd 1991), based upon the notion that a new breed of professional could emerge, people who could operate in the spaces between the social sciences on one side, and engineering and technology on the other. Such people would be capable of taking into account both sides of technology and would use their knowledge to design technologies more acceptable to society than those that might emerge from a more technology-oriented approach.

The above of course is not a new idea, having its roots in the Sociotechnical School, (Cherns 1976, 1987), and developed further in other contexts, e.g. manufacturing technologies (see Rosenbrock (1989), Kidd (1988, 1992). A key point about the Sociotechnical School, and other similar philosophies, however, is that the bulk of the existing body of knowledge and experience was developed for workplace environments, something which continues in the context of ISTs, e.g. mobile computing (Sawyer and Tapia, 2005).

The emergence of ISTs and the concept of Ambient Intelligence moves the consideration of the relationships between technology and people, out from the workplace, into different settings, e.g. the home. But the purpose behind technology also changes, for no longer is technology primarily driven by utility, as it is in the workplace, since other considerations such as fun, emotions, exploration, etc. must also be addressed.

As a consequence of the above factors it is timely and relevant to begin to ask questions about the relevance of existing knowledge and techniques from the social sciences, primarily developed in the context of the workplace user, for example the Sociotechnical School, and what if anything can be applied to the design of IST and Ambient Intelligence systems, in non-workplace environments, where utility is not necessarily the driving force. Moreover, consideration may also need to be given to possible adaptations of existing knowledge and principles, to make these more appropriate to the new circumstance.

This paper addresses the topic of the development of new conceptual and theoretical frameworks that could underlie an interdisciplinary profession of the type mentioned above. To begin this journey towards the development of new conceptual and theoretical frameworks, some of that which has already been developed in the workplace context will be analysed. This analysis is undertaken within the context of two general classes of IST (interactive and non-interactive) that provide a means of considering the usefulness of the existing *social shaping of technology* knowledge base. Considered in the paper are sociotechnical design principles (Cherns 1976, 1987), as well as a more recent theory and concept, known as *interfacing in depth*, developed for the interdisciplinary design of advanced computer-based manufacturing technologies (Kidd 1988, 1992). The conclusions from these analyses are presented, along with suggestions and recommendations for further research in this domain. A new sociotechnical design principle is also proposed that deals with the issue of purpose in non-workplace environments.

Analysis Framework and Objectives

The primary aim of the conceptual and theoretical research addressed in this paper, was to undertake an initial assessment of existing knowledge, primarily developed and deployed in the workplace context, for its relevance to non-workplace environments. To enable this, two specific single-user technologies were considered, based on a simple taxonomy of ISTs. Group oriented technologies were not addressed in this work, they being an area where further specific consideration is needed. Specifically, the categories of ISTs considered were interactive and non-interactive. These terms have the following meanings for the purpose of the research:

> *Interactive*: an IST that involves an interaction over (often medium to long) periods of time in which the outcome and results cannot be predefined.
> *Non-interactive*: an IST that involves an interaction, over (often a short) period of time in which the outcome is clear and expected.

An example of the former would be an internet search via a search engine, and of the latter, the purchase of rail or air tickets through a web site.

The use of the term interactive therefore relates to uncertainty and predictability, and the amount of decision making under these condition that is required to progress to a conclusion, and not to a more simple notion of a user pressing keys, or responding to predefined options. Non-interactive does not therefore imply that no involvement is expected from a user, although this could be the case, but that in the case of a non-interactive IST, the level of interaction is equivalent to using a vending machine, and capability to use such systems can be taken for granted from the perspective of population skill norms. Of course this does not imply that there are people in society who would not have problems with such systems, but this is not the focus of the research, nor of interest from the perspective of the differentiation between the technologies.

Note that the taxonomy used was chosen for its simplicity to make some initial explorations. However, it is not one that would or should be used for further work in this field, and indeed the limitations of the taxonomy in relation to the work considered are addressed in the conclusions.

For the purpose at hand, one example of each type of IST was considered. For the case of a non-interactive IST, online purchasing of tickets was addressed. This was chosen for its conceptual simplicity, for its ease of use from the perspective of a non-workplace user, and because this sort of application is now fairly mature and ubiquitous. It was also chosen because it is an example of an IST is that is used both in the home environment, and in the work environment. The relevance of this is explained shortly.

For the case of an interactive IST, semantic web technologies were considered. The reasons for the choice of this technology are exactly opposite to those listed above for the non-interactive IST. In other words, semantic web technologies are not simple, are still under development, and are not widely used outside the workplace. In fact they have still yet to be widely deployed in business, but the potential benefits for the world of business could be significant.

At this point it is necessary to briefly explain the semantic web, via a comparison with the non-semantic web, that is to say, the web of the present. The problem with web search engines (such as Google), is that they do not understand the words that people type into them or the uers' purpose. What for example does the word *bank* mean? Does the user want to search for information on financial institutions, or for information about steep hills, or for information about an aircraft manoeuvre? With the present generation of web technologies, such a query would deliver answers linked to all three (and possibly other things). The semantic web offers the promise of a web where meaning is understood, but this is proving hard to deliver. However the downside of the semantic web is that it could eliminate the chaotic and serendipitous nature of the web. This is why it is used here for the present work, because of its relationship with unpredictability of outcomes.

Here now is an appropriate point to consider the issue of why it has been considered important to address technologies that have a duel use, in both workplace and in non-workplace environments. Primarily this is linked to unpredictability and uncertainty in the business environment, which challenges many taken-for-granted business practices. Often businesses focus their attention on becoming more efficient, and reducing uncertainty and unpredictability in work processes is one way that this can be achieved. However, uncertainty and unpredictability in the business environment cannot so easily be controlled, and creativity, problem solving capabilities and ability to adapt in the face of uncertainty and unpredictability requires a different sort of culture, one where serendipity, chaos, exploration, divergence, and the unconventional are fostered. This in many ways mirrors the sort of behaviour that pertains to the use of the internet in home environments. Thus there is also an interest in understanding how design for non-work environments might reflect back into work environments to provide a technology better suited to prevailing business conditions, where agility (Kidd 1994, 1997, 2008) is becoming increasingly important.

Analysis from the Sociotechnical Perspective

The Sociotechnical School of social sciences developed in the United Kingdom starting in the immediate years following the Second World War. It is founded on the view that in the workplace, technology is just one part of a system, there being also a social system, and that in theory both can be designed (or redesigned) to make the whole system more effective, both from the perspective of people and their needs, as well as the objectives associated with a particular work process. This opens up the possibility to change or design technology taking into account social science considerations.

There is a large body of literature attached to this school of thought, representing 60 years of research and application. A key feature of the Sociotechnical School is that there exists a set of principles (Cherns 1976, 1987) that embody the values and key features of sociotechnical design. Apart from the obvious attractiveness of the sociotechnical philosophy as means of undertaking social shaping of technology, the existence of these principles lends the approach to analysis of ISTs and consideration of the relevance of these principles outside the work environment that has formed the basis for much of the development of the sociotechnical approach.

To save space, the principles will not here be elaborated upon in great detail. Readers are referred to Cherns (1976, 1987) for further details of the principles. Altogether there are eleven principles:

- Compatibility;
- Minimum Critical Specification;
- Variance Control;
- The Multifunctional Principle-Organism vs. Mechanism;
- Boundary Location;
- Information Flow;
- Support Congruence;
- Design and Human Values;
- Incompletion;
- Power and Authority;
- Transitional Organisation.

To avoid repetition and length, the relevance of the majority of these principles to the two ISTs considered will be addressed simultaneously, and by grouping the principles.

Considering the relevance of these principles to the two technologies addressed, it is immediately apparent that there is a sub-group of principles that are largely organisational in nature. These are: *The Multifunctional Principle - Organism vs. Mechanism*; *Boundary Location*; *Information Flow*; *Support Congruence*; and *Power and Authority.*

The *Multifunctional Principle – or Organism vs. Mechanism* refers to traditional organisations which are often based on a high level of specialisation and fragmentation of work, which reduces flexibility. When a complex array of responses is required, it becomes easier to achieve this variety if the system elements are capable of undertaking or performing several functions. *Boundary Location* is a principle that relates to a tendency in traditional hierarchical organisations to organise work around fragmented functions. This often leads to barriers that impede the sharing of data, information, knowledge and experience. Boundaries therefore should be designed around a complete flow of information, or knowledge or materials, or all three, to enable the sharing of all relevant data, information, knowledge and experience. The *Information Flow* principle addresses the provision of information at the place where decisions and actions will be taken based on the information. *Support Congruence* relates to the design of reward systems, performance measurement systems, etc., and their alignment with the behaviours that are sought from people. For example, individual reward for individual effort, is not appropriate if team behaviour is required. *Power and Authority* is concerned with responsibilities for tasks, and making available the resources that are needed to fulfil these responsibilities, which involves giving people the power and authority to secure these resources.

Given the organisational design nature of these five principles, do they have any relevance to the shaping of the single user interactive and non-interactive ISTs considered? For all five principles there is no obvious significant link, although this probably will not apply to the case of group-oriented ISTs. In such group circumstances, for example, *Boundary Location* and *Information Flow* might be important since these can relate to technology design by virtue of the functions and access that are designed into systems that will enable different people to access information that is stored in such systems.

There is another group of principles that largely relate to the process by which technology is designed. These are: *The Compatibility Principle*; *The Incompletion Principle*; and *The Transitional Organisation Principle*.

The *Compatibility Principle* states that the process by which technology is designed needs to be compatible with the objectives being pursued, implying that technologies designed without the involvement of users, would not be compatible with the aim of developing a participatory form of work organisation where employees are involved in internal decision making. *Incompletion* addresses the fact that when workplace systems are designed, the design is in fact never finished. As soon implementation is completed, its consequences become more evident, possibly indicating the need for a redesign. The *Transitional Organisation* principle addresses two quite distinct problems when creating new organisations: one is the design and start-up of new (greenfield) workplaces, the other relates to existing (brownfield) workplaces. The second is much more difficult than the first. In both situations, the design team, and the processes it uses, are potentially a tool to support the start-up and any required transitions.

The relevance of these principles to the workplace is self evident, but how relevant are they to the non-workplace environment?

Whilst the involvement of users in the design of any technology that is used by people is desirable, and often a necessity, the *Compatibility Principle* does not focus on this issue. Rather it considers the compatibility, or lack of it in circumstances where managers on the one hand seek to develop a participatory culture, and then fail to allow employees to be part of the process of workplace technology selection or design. For the case of the non-workplace environment, this does have some relevance, but not to the same degree as the workplace. In the case of the non-interactive technology of online ticketing, this is ubiquitous, and outside the control of most users, who just take it as it. Likewise for the case of semantic web technologies, which will be developed and then used by a community of users. So the principle of compatibility does not apply to any great extent in non-workplace settings.

For the *Incompletion Principle* a similar argument applies. No technology or technical system is ever complete, so improvements are likely to be made, some of which will relate to experience from use. But this is outside the control of most users. And for the case of the *Transitional Organisation Principle*, the focus of this is on processes of change liked to technology development and implementation, and using this as a means of bringing about organisational transformation. Hence its relevance to the single user ISTs considered is not evident.

What remains from the set of sociotechnical design principles, is a sub-set that is significantly technology oriented, although the principles also have organisational implications. The principles in question are: *Minimum Critical Specification*; *Variance Control*; *Design and Human Values.*

Given the strong links with technology design, these three principles will be considered one by one rather than being addressed as a group of principles.

The principle of *Minimum Critical Specification* states that only what is absolutely necessary should be specified, and no more than this, and that this applies to all aspects of the system: tasks, jobs, roles, etc. Whilst this is organisational in nature, it impacts technology as well. It implies that what has to be done needs to be defined, but how it should be done should be left open. In terms of features and functions of technology, the technology should not be over determined, but should leave room for different approaches. It implies a degree of flexibility and openness in the technologies.

What about the relevance of this principle to the non-workplace environment? Considering first the case of the online ticketing system, beyond obvious choices like dates, payment methods, etc., this principle has no significant relevance, indeed it could be a recipe for disaster in such systems if there were openness to different user preferences with respect to use. However, considering semantic web technologies, the exact opposite circumstance can be observed, because the outcome of the use of this type of technology is simply not known in advance. Consequently, to overdetermine how the technology is used, could potentially be incompatible with the purpose of the technology and its value to users.

Turning now to *Variance Control*, this is a principle that, as its name suggests, is focused on handling variances, these being events that are unexpected or unprogrammed. Variances which cannot be eliminated should be controlled as near to the point of origin of the variance as possible. Some of these variances may be critical, in that they have an important affect on results. It is important to control variances at source, because not to do so often introduces time delays.

In the case of online ticket sales there should be no variances at all, that is to say variances should be foreseen, and either eliminated or addressed by being built into the system through user choices. Consequently, variance control, that is say, the control of variances, should be minimised down to predefined choices so that the user is not faced with the need to handle variances. As such, variance control does have a relevance to the on-line purchase of tickets, but only in the sense that it should not be required of a user. With respect to semantic web technologies however, variance control is potentially very important, but not for the same reasons that it is important in workplace environments. One of the potential downsides of the semantic web is that it eliminates variances in web search results, thus destroying some of the value of the web (the experience of discovering the unexpected). Consequently, enabling the user to decide how much variance to tolerate, in other words to place control of variances in the hands of users, could be important attribute that needs to be designed into the semantic web, and for this reason variance control is potentially an important principle for the non-workplace environment.

Next on the list of principles is that of *Design and Human Values*. This is concerned with quality of working life. In the context of the working environment it manifests itself in issues such as stress, motivation, personal development, etc, This principle has both a social sub-system dimension and a technology sub-system dimension, in that both can be designed to reduce stress, and to enhance motivation and personal development. Therefore there is, in principle, a connection to the technologies being considered. This connection primarily manifests itself in the form of design features. In the case of non-interactive technologies this is primarily addressed through usability and human-computer interface issues. In the case of interactive technologies such as the semantic web, in addition to the user interface considerations, the key issue is that of control. Control is important because not to have control over technology such as the semantic web, for users not to be able to decide which features of the technology should be employed, reduces the semantic web to that of a vending machine for search results. This could be highly de-motivating to users of the semantic web.

Interfacing in Depth

This perspective on the social shaping of technology rests on the observation (Kidd 1992) of the importance of technology in influencing organisational choice and job design. Conventional wisdom (e.g. see Clegg 1984) suggests that technology is of secondary importance with respect to job design and organisational choice. However, technology is clearly not neutral and can close off options and choice in the design of organisations and jobs. Technology for example can be used to closely circumscribe working methods, to limit freedom of action and autonomy, and to determine the degree of control that users have over the work process.

This viewpoint, of technology shaping organisations, roles, and working methods, led to the notion of *interfacing in depth*. So rather than just applying ergonomic and usability considerations to the design of human-computer interfaces, it was proposed that there is a need to apply psychological and organisational science insights to the design of the technology behind the interface.

Kidd (1988) describes a decision support system that was designed using this broader perspective. A key point about this decision support system is that the system characteristics were not achieved through the application of ergonomics or usability considerations to the design of the human-computer interface; the characteristics arose from the technology, not from the human-computer interface.

Kidd (1988) points out that it is necessary therefore to make a distinction between the surface characteristics of a system, as determined by the human-computer interface, and the deeper characteristics of a system, as determined by the actual technology. The surface characteristics are strongly related to ergonomics and usability, while the deeper characteristics relate more to the view of the user held by the designer, in that if those values are driven by a desire to reduce user autonomy, this will be reflected in the details of the underlying technology. Likewise if values are such that autonomy is valued, then this will lead to a different type of underlying technology.

Consequently, good human-computer interface (surface) characteristics are necessary, but not sufficient. Attention must also be paid to the deep system characteristics, that is, the technology behind the human-computer interface. Technology here means the algorithms, rule bases, databases, architectures, etc. This is called *interfacing in depth*.

The first observation to make about this *interfacing in depth* approach is that it is not relevant to the case of non-interactive technologies. The whole philosophy of *interfacing in depth*, is based on design of technologies where there is uncertainty and unpredictability in terms of outcomes. The approach also provides a framework to counter the tendency to reduce human-computer encounters to circumstances where there is no uncertainty and unpredictability in outcomes. Clearly this would be undesirable in some circumstances, such as online ticket purchases. But the theory is highly relevant to interactive technologies such as the semantic web, for this approach would seek to allow user autonomy and control to flourish, thus maintaining the potentially chaotic and serendipitous nature of the worldwide web, but at the choice of the user.

Achieving this of course requires a sophisticated design approach, something that is far beyond the scope of this paper. Further details of one such approach can be found in Kidd (2007b).

Conclusions and Discussion

From the analysis presented, based on the preliminary study considered, which is founded upon theoretical considerations, a number of conclusions can be drawn.

The first conclusion relates to the taxonomy used in the work reported in this paper. This taxonomy is clearly rather simple, and was chosen for this very reason to enable a first consideration of the relevance of two particular perspectives to two specific single-user ISTs. For this purpose it has proved useful, but it does not capture the full range of possibilities that lie between what are, in effect, two extremes. A more elaborate taxonomy, one that does capture better the different characteristics of ISTs, needs to be developed. A possible additional dimension that could be considered is control versus information feedback, as considered (p320) in Kidd (1994). This might provide a means of selecting a fuller range of ISTs with different control and information feedback characteristics, which would allow a wider range of ISTs to be selected for analysis purposes.

The second conclusion is that the bulk of the sociotechnical criteria are either organisational in nature or design process oriented, and, as a consequence of this, they, outside the workplace environment, have little or no relevance, at least for single-user ISTs. Their relevance in the context of group-oriented ISTs will be the subject of further analysis in the future.

Those sociotechnical design criteria that the analysis does suggest have a relevance to the design of IST outside the workplace environment, are the principles of *Minimum Critical Specification*; *Variance Control*, and *Design and Human Values.* However, the analysis also suggests that there is greater relevance to the design of interactive ISTs such as the semantic web, than to the design of non-interactive technologies. The reason for this finding probably lies with the lack of unpredictability and uncertainty regarding outputs and eventual results emerging from the latter, which in effect means a highly automated process with no need for user intervention other than to specify certain inputs. These three sociotechnical criteria therefore have their greatest relevance outside the workplace for cases where ISTs are connected with significant unpredictability and uncertainties with respect to outcomes.

The fourth conclusions is that the *interfacing in depth* philosophy also delivers a similar outcome with regard to relevance to non-interacting ISTs. Its relevance to such ISTs is minimal, but the approach is highly suitable for designing interactive ISTs, given the unpredictability and uncertainty concerning outcomes. This is not surprising however, given that *interfacing in depth* was developed precisely to deal with this latter type of technology.

However, one issue that is not so evident from the considerations so far, is the nature of design requirements. Variance control taken from the set of sociotechnical design principles is one perspective which points to a formulation of design requirements, and this variance control perspective is one set of requirements that can be addressed through *interfacing in depth*. There is something missing however. One of the problems that surround both methods, given their roots in the workplace context, is their focus on utility. Technology in the workplace exists to fulfil functions that relate to work. But technology in non-workplace environments exists for additional purposes, such as entertainment, amusement, exploration, etc. and these are not elements which, at present, sit well with the sociotechnical method.

To overcome this a new sociotechnical principle is needed, one that captures purpose in the context of the non-workplace environment. This could be referred to as the *Non-utility Principle*, which can be articulated as:

Non-utility Principle: IST in non-workplace contexts serve purposes beyond mere utility, and ISTs should be designed to enable users to achieve emotional fulfilment through play, exploration, and several other dimensions, that are not traditionally associated with workplace environments.

This of course raises some design issues that need to be better defined. It could also be the case that this new principle could be relevant to the workplace, which is something that needs further consideration.

One issue that is rasied by the *Non-utility Principle* is that of the relationship of ISTs and non-utility with the notion of Ludic Systems (Gaver 2008), Ludic being an obscure word meaning playful, but in a very wide sense, including learning, exploration, etc. This perspective does not just characterise people by thinking or achievements, but also by their *ludic* engagement with the world: their curiosity, their love of diversion, their explorations, inventions and wonder. Play is therefore not just perceived as mindless entertainment, but an essential way of engaging with and learning about the world and the people in it. Underestimating the importance of this, it has been argued (Gaver 2008), is a key element creating the pervasive distortions that technology makes to culture.

To conclude therefore, whilst there is some evidence of relevance of sociotechnical design principles and the *interfacing in depth* method to the design of ISTs in non-workplace environments, the existing knowledge-base does appear to require extension and adaptation. What this actually amounts to in detail has yet to be fully explored and defined.

References

Aarts, E. and Marzano, S., (eds.), (2003). *The New Everyday: Views on Ambient Intelligence*, Rotterdam: 010 Publications.

Cherns, A. (1976). Principles of Sociotechnical Design, *Human Relations*, 29(8), 783-92.

Cherns, A. (1987). Principles of Sociotechnical Design Revisited, *Human Relations*, 40(3), 153-62.

Clegg C.W. (1984). The Derivation of Job Design. *Journal of Occupational Behaviour*, 5, 131-146

Corbett, J.M. (1985). Prospective Work Design of a Human-Centred CNC Lathe, *Behaviour and Information Technology*, 4, 201-214.

Ducatel, K., Bogdanowicz, M., Scapolo, F., Leijten, J. and Burgelman, J-C. (2001). Scenarios for Ambient Intelligence in 2010, ftp://ftp.cordis.europa.eu/pub/ist/docs/istagscenarios2010.pdf

Gaver, W. (2008). Curios Things for Curious People, http://www.goldsmiths.ac.uk/interaction/pdfs/36.gaver.curiousThings.inPress.pdf

ISTAG, (2004). Experience and Application Research: Involving Users in the Development of Ambient Intelligence, ftp://ftp.cordis.europa.eu/pub/ist/docs/2004_ear_web_en.pdf

Khattab, I. and Love, S. (2008). Mobile Phone Use Across Cultures: A Comparison Between the United Kingdom and Sudan, *International Journal of Technology and Human Interaction*, 4(2), 35-51.

Kidd, P.T. (1988). The Social Shaping of Technology: The Case of a CNC Lathe, *Behaviour and Information Technology*, 7(2), 193-204.

Kidd, P.T. (1991). Interdisciplinary Engineering Design: Life Without Boxes, *Proc. IEE Colloquium on Professionalism in Engineering Design: European Perspectives*, London, UK.

Kidd, P.T. (1992). Interdisciplinary Design of Skill Based Computer-aided Technologies: Interfacing in Depth, *International Journal of Human Factors in Manufacturing*, 2(3), 209-228.

Kidd, P.T. (1994). *Agile Manufacturing: Forging New Frontiers*, Wokingham: Addison-Wesley

Kidd, P.T. (1997). The Agile Manufacturing Enterprise: Implications for Technology Design Practices, Keynote Address, *Proc ALLFN'97*, Galway, Ireland.

Kidd, P.T. (ed.) (2007a). *European Visions for the Knowledge Age: A Quest for new Horizons in the Information Society*, Macclesfield: Cheshire Henbury Publications.

Kidd, P.T. (2007b). Human-centred Ambient Intelligence: Human-computer Relationships for the Knowledge Era, in Kidd, P.T. (ed.) *European Visions for the Knowledge Age: A Quest for new Horizons in the Information Society*, Macclesfield: Cheshire Henbury Publications.

Kidd, P.T. (2008). Agile Holonic Network Organizations, in *Encyclopedia of Networked and Virtual Organizations*, Putnik G.D. and Cunha, M.M., (eds.), Hershey: IGI Global Publications.

Rosenbrock, H.H. (ed.) (1989). *Designing Human Centred Technology: A Cross-disciplinary Project in Computer-aided Manufacturing*, London: Springer-Verlag.

Sawyer, S. and Tapia, A. (2005). The Sociotechnical Nature of Mobile Computing Work: Evidence from a Study of Policing in the United States, *International Journal of Technology and Human Interaction*, 1(3), 1-14.

Weiser, M. (1991). The Computer of the 21st Century, *Scientific American*, 265(3), 66–75.

About the Author

Dr. P.T. Kidd

Paul Kidd is an engineer by training, but has spent the majority of his career working on the application of social sciences to technology design, and the development of interdisciplinary design methods. He has published several papers in this domain concerned with theories and concepts, as well as applications. He has participated in many research projects that have involved collaboration between social scientists and technologists.

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