Landscapes of Ethical Issues of Emerging ICT Applications in Europe

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Abstract

A central problem of the attempt to bring to bear ethical ideas to technology, in particular information and communication technology is that it tends to arrive too late. It would clearly be desirable to have a better understanding of future technological developments in order to allow ethical considerations to influence design and implementations of technology. At the same time, the unavoidable contingency of future developments provides a fundamental limit to what we can know about the future. The current paper explores how this problem can be addressed. It provides a framework of technical developments that one can reasonably expect to materialise in the medium term future (10 to 15 years) and ethical issues that are currently expected to arise. This is done by analysing current European research funding documents with a view to exploring the trends, purposes, applications, artefacts, ethical issues, and governance structures that the European Commission foresees. The overall aim of the paper is to provide the conceptual basis of this framework.

Keywords

ICT ethics, emerging technologies, applications, research framework, Europe, FP7

INTRODUCTION

A central problem of the ethics of technology is that it tends to arrive too late. In many cases ethical issues are only recognised when the technology is already on the market and problems arise during its wide-spread use. Ethics can then become a tool to clean up a mess that might have been avoidable. It is probably not contentious to say that it would be desirable to have ethical input at the earlier stages of technology design and development. Indeed, there are ethical theories and approaches that explicitly aim at an early integration of ethics int0 the technology life cycle (van den Hoven, 2008). One central problem of this type of approach is that the future is unknown. By definition we do not know with certainty what will happen in the future and an ethics that relies on future development needs to be able to answer the question how it decides which technological developments to pursue. Ethics has traditionally not been well equipped to deal with issues of uncertainty (Sollie, 2007) and in particular future uncertainty.

The present paper aims to contribute to this discussion. Its approach is to identify likely scenarios of future ICT developments that are grounded in empirical facts. The idea is thus to strike a balance between unavoidable speculation when talking about the future and factual grounding necessary for academic research. This paper should be understood as a first step in identifying future developments in ICT. The chosen approach is to concentrate on an identifiable and relevant regional and policy area, namely the European Union. It aims to give a high level overview of the European landscape of emerging information and communication technologies. Its purpose is to come to an understanding of the ICTs that are likely to develop in the next 10 to 15 years with a view to understanding which ethical issues we can expect and how we may best prepare to meet them. This will lead to policy recommendations for the European Union as well as advice for individuals and organisations involved

in technology development. The paper is meant to provide the grounding necessary to develop empirical work. It will develop categories of ICTs and ethical issues which will be used to investigate specific ICT research projects in order to assess whether and how ethical issues are currently taken into consideration and how policies need to be developed.

The paper will start by giving an introduction to the European research structure with a particular emphasis on the 7th Framework Programme. It will then analyse how the EU views the development of ICTs by analysing trends, applications, artefacts, ethical issues, and governance approaches as they can be identified from current EU publications.

CONCEPTUAL BASIS

Before we move to a detailed discussion of the European landscapes of technology, it is important to outline briefly the context of this paper. This will start with a description of the 7th Framework Programme. We then outline our concept of ICT ethics. Finally, we discuss some of the policy background that informs the European Union's view of technology, and gives reasons for the plans and resource allocations that are meant to shape the development and use of technology. The section finishes with some considerations concerning the methodology of this paper.

The 7th Framework Programme for Research and Technological Development (FP7

The European Union has a long tradition of fostering research and development through so-called framework programmes. The current 7th framework programme (FP7), which runs from 2007 to 2013, has a total budget of over €50 billion. The majority of this money is and will be spent on research grants, predominantly in Europe. Research to be co-sponsored by such grants is chosen on the grounds of calls for proposals and following a competitive peer review process. Given that there are national research funding mechanisms in many European countries, the European framework funding has the additional characteristic of being centred on international collaboration. The European Commission names two main aims of the framework programme (European Commission, 2007, p.7): "to strengthen the scientific and technological base of European industry [and] to encourage its international competitiveness, while promoting research that supports EU policies." One aspect of FP7 is that it is meant to contribute to the European Research Area (ERA) (http://cordis.europa.eu/era/concept_en.html), which aims to overcome the weaknesses of European research caused by its fragmented and dispersed nature.

In order to meet the broad objectives of FP7, the programme has been divided into four categories: Cooperation, Ideas, People and Capacities. Each of these is then sub-divided into further categories and sub-programmes. The core of FP7 is the Cooperation programme, which is used to fund collaborative projects involving partners from at least three European Member States. This programme has been further divided into ten key thematic areas:

- health;
- food, agriculture and fisheries, and biotechnology;
- information and communication technologies;
- nanosciences, nanotechnologies, materials and new production technologies;
- energy;
- environment (including climate change);
- transport (including aeronautics);
- socio-economic sciences and the humanities;
- space;
- security.

The Ideas programme aims to support "frontier research", and funding is based on scientific excellence, without the need for cross-border collaboration. The People programme supports researcher mobility across Europe and the Capacities programme aims to strengthen research capacities of Europe. This paper will concentrate on the Cooperation programme and, more specifically, on its Information and Communication Technologies sub-programme. This is justified by the particular emphasis on ICTs

of the project. While it stands to reason that ICTs will be developed in other areas of FP7, the ICT work programme is specifically focused on them. In addition, the ICT programme is the largest of all sub-programmes with a budget of over €9 billion over the lifetime of FP7 (http://cordis.europa.eu/fp7/budget_en.html).

A final word of justification of the choice of concentrating on European ICT research programme needs to be said given that this paper aims to investigate the global phenomenon of ethics in ICTs. One might ask why a paper published in a special issue on software engineering in the digital world should concentrate on a particular regional funding scheme. In addition to the practicalities of this paper being a result of a European research project, one can also easily argue that the EU is one of the most important economic and political entities and that its research policy has the potential of shaping future technical and economic standards. With a population of around 500 million and a gross domestic product (GDP) that represents about one third of the world's GDP, it has significant international power. The European view of ICT is important because it is developed in intercultural discourses with scientists and researchers worldwide. It shows the ways that policy makers perceive the role of ICT. At the same time, it has the potential to shape future developments. This refers to the funding available via FP7 but maybe more importantly to the many ways in which the European Union has to set policy that can shape the way technology is designed or used. While this paper and the underlying project are thus concentrating on a particular region, we believe that our findings should be of interest more generally and are likely to be transferable at least to a considerable degree.

ICT Ethics

Ethics can then be defined as the philosophical study or reflection of morality (Adam, 2005; Weil, 1969). In everyday language and even in much academic writing this distinction is not always observed (Forester, 1994; Weckert, 1997). However, the distinction between social norms and their reflection is important to observe if one wants to come to a measured understanding of normative issues and their ethical evaluation. Ethics as the reflection of morality can have different tasks. There is a distinction between descriptive ethics, normative ethics and metaethics (Marturano, 2002).

In this project the term "ICT ethics" will be used to denote ethical issues that arise from or in conjunction with ICT. Work in ICT ethics can be distinguished along the lines of the earlier distinction of ethics in general, namely in descriptive, normative, and metaethical. The different types of investigation are often undertaken by scholars from different disciplines. Descriptive ICT ethics work is typically done by researchers with a technical, social science or information systems leaning (Moores and Chang, 2006). Normative and in particular metaethical work is frequently undertaken by scholars with a background in philosophy (Bynum, 2006; Floridi, 2006; Introna, 2002; van den Hoven, 1997).

Research in ICT ethics is often multidisciplinary and attempts to come to a broad understanding of the subject at hand. Much research is focused on specific issues and problems. Among the most prominent ones one can find issues such as privacy (Brown, 2000; Introna, 2003), intellectual property (Burk, 2001; Syme and Camp, 2002), access and digital divides (Rooksby and Weckert, 2006), data quality (George, 2002), but there are many others. It often overlaps with related discourses in neighbouring disciplines, e.g. computer law (Poullet, 2004).

Much work in ICT ethics engages with the normative question how normative problems can be addressed in an ethically sound way. A typical approach that tends to be adopted is the adoption of some sort of behavioural guideline, policy or code (Siau, Nah, and Teng, 2002). Some of the most important professional bodies have gone down the route of a code of ethics, for example the British Computer Society (http://www.bcs.org/server.php?show=conWebDoc.1587) or the Association for Computer Machinery (http://www.acm.org/about/code-of-ethics). Codes of ethics can raise as many problems than they solve (Fairweather, 2000; Ladd, 1985). Alternative forms of governance have therefore been discussed.

The aim of this paper is not to champion any of the applications or approaches but to develop a framework that will allow us to capture work currently going on with a view to providing a more holistic understanding of research questions and expected future developments.

Policy Aims

Current public policies, in particular EU regulations, are pertinent to issues of ICT ethics and influence the outcomes of our paper. Normative perceptions and their ethical evaluation strongly influence what democratic governments perceive as issues to regulate. In current EU policy there are several areas where normative and ethical issues of ICT are addressed. ICT research has been identified as one of the three pillars of the "i2010 – A European Information Society for growth and employment" initiative of the European Commission. i2010 is renewing the Lisbon agenda and relies heavily on ICT to realise efficiency and economic gains. (http://ec.europa.eu/information_society/eeurope/i2010/introduction/index_en.htm)

The EU furthermore views ICT as a main tool in addressing its demographic challenges. In its Green Paper "Confronting demographic change: a new solidarity between the generations" (European Commission, 2005), the Commission has outlined the challenges the Union is facing. The demographic development continues to be a main area of concern for the EU (cf. "The demographic future of Europe – from challenge to opportunity", European Commission, 2006). Three general trends combine to create the problem of decreasing population: continuing increases in longevity, continuing growth of the number of workers over 60, and continuing lower birth rates. The EU intends to address the resulting problems with a variety of strategies. Among them there is the aim to use ICT to allow older people to remain an active part of society but also to allow them to remain independent in their homes. This has economic implications for health and social care but, more importantly, it is a matter of the quality of life for EU citizens.

The aims of the European ICT policy are broad and arguably contradictory. The aim of increasing competitive advantage, for example, can very easily lead to the use of ICT to replace traditional workplaces. Wiring companies and creating digital infrastructure can have the unintended result of facilitating outsourcing, thus further limiting the stated European aim of creating employment. To some degree the question of the net effect of technical development on the labour market is an empirical question. However, the ICT policies can also be contradictory in other aspects. The inclusion of disadvantaged groups in social processes is a highly ethically relevant aspiration. At the same time, evidence from the digital divides literature suggests that the provision of technology can exacerbate existing barriers to social participation. The EU is aware of this and digital inclusion with all its implications is high on its list of priorities. An interesting question remains, however, whether general policy aims and the ICT research agenda that is investigated in the present paper are consistent.

The first section of the ICT work programme 2009 summarises the policy aims behind the EU ICT research initiatives (European Commission, 2008a, p. 4) as:

"Improving the competitiveness of European industry and enabling Europe to master and shape future developments in ICT so that the demands of its society and economy are met ICT is at the very core of the knowledge-based society. Activities will continue to strengthen Europe's scientific and technology base and ensure its global leadership in ICT, help drive and stimulate product, service and process innovation and creativity through ICT use and value creation in Europe, and ensure that ICT progress is rapidly transformed into benefits for Europe's citizens, businesses, industry and governments. These activities will also help reduce the digital divide and social exclusion. "

Methodological Considerations

While this paper is fundamentally of a conceptual nature and explores possible and likely futures to allow the development of more detailed research agendas, it nevertheless needs to be grounded in a shared social reality to gain acceptance of the variety of audiences who have an interest in ethical issues of emerging ICTs. In order to provide a transparent and shared account of likely developments, the empirical basis of the paper was based on a content analysis of a range of sources. Primary among these were documents created by the European Union with regards to policy planning, in particular of the 7th Framework Programme. In order to supplement and contextualise these, other sources on ICT, its future developments and ethical issues were considered. The content analysis was conducted by reading the documents with a view to the following items: applications of future technology, artefacts, ethical issues, governance structures, and others. The findings of the analysis were stored in a mindmap for easier reproducibility and then used for summarising the findings below.

EUROPEAN LANDSCAPES

This section shows the major areas of technological development in ICT as well as ethical and governance aspects related to it. It is broken down according to the main items used for the data analysis: trends, applications, artefacts, ethical issues, and governance structures. The first attempts to provide an overall view of where ICT is going. The two sections on applications and artefacts relies heavily on the most recent call for ICT projects at the time of writing this document, which is the FP7 ICT Call 4, published on 19 November 2008 with a submission deadline of 01 April 2009 (European Commission, 2008a). This is the document that explains in most detail the aims and objectives of the ICT work programme and thereby gives an exact view of what European policy makers believe to be desirable and realistic. Further documents are drawn upon where necessary.

ICT Trends

Those who have tried to forecast the next technological advances are usually incorrect. ICT has a track record of unpredictability in the specific nature and consequent impact of these future advances. The only certain thing is that there will be always be significant advances and these will always impact upon society and its people. However, several general ICT trends can be seen even though the specifics are unpredictable. It is such trends which influence the overall strategic approach, for example, to national and European research funding and to societal acceptance or rejection of technology. Vaughn (2006 pp8-14) suggests that there are four key ICT trends.

- ICT trend 1: Ever-increasing computational power plus decreasing size and cost
  The move towards more computational power, with decreased size and cost, can make possible improved and entirely new types of technology and new application opportunities.
- ICT trend 2: Technology advances enabling new types of interfaces
  The human interface is one of the most important determinants of whether a technology product can be used by people regardless of their skill, experience, affliction or disability. For example, advances in interface technology are creating new opportunities for better assistive technologies, more accessible mainstream technologies, and entirely new concepts for controlling both. Some of the more innovative interfaces include augmented reality, hands-free operation, voice control and direct control from the brain.
- ICT trend 3: Ability to be connected anywhere, anytime with services on demand
  The latest innovations such as wireless electronics, location awareness, wearable technology and implantable technology point towards a society with widespread connectivity. This allows people to think about communication, control and presence in entirely new ways.
- ICT trend 4: Creation of virtual places, service providers and products
  Web technologies have provided people with new ways of doing things hitherto not thought of or not possible. Such technologies have fostered the development of entirely new social, commercial, and educational concepts.

The evolution of ICT through such trends could impact upon everyone both positively and negatively. This is explored in detail by both Roe (2007) who uses a SWOT analysis and Vaughn (2006) who considers opportunities and barriers. Floridi (2007) considers such trends at a meta level and argues that 'in information societies, the threshold between online and offline will soon disappear, and that once there won't be any difference, we shall become not cyborgs but rather *infORGs*, i.e. connected informational organisms.' If this is the case then the ethical dimension of ICT becomes the ethical dimension of society per se.

Applications and Challenges

In this paper we distinguish between applications and artefacts that may give rise to ethical issues. This distinction is not reflected in the ICT Call 4 (European Commission, 2008a) but it is plausible to make this distinction. By applications we mean areas where ICTs can lead to solutions or applications. Artefacts, on the other hand, are software, hardware, or related items that can be used for particular purposes. There is often a relationship between applications and artefacts and in many cases artefacts

are built specifically for particular applications. However, artefacts can usually be used in different ways and different artefacts can be used for the same applications. Since ethical issues can arise in a number of ways, including the non-intended use of artefacts, we believe that the analytical distinction between applications and artefacts is helpful to our overall aim of identifying ethical issues of emerging ICT applications.

The applications that the EU views as relevant for the next 10 to 15 years are reflected in the main challenges. These challenges are divided into two groups: "overcoming technology roadblocks and reinforcing Europe's industrial strengths" and "seizing new opportunities and applying ICT to address Europe's socio-economic challenges". The first group contains those challenges which can be seen as technological in nature, which seems to imply that their social and economic context is less important or maybe unproblematic. The first one of the three technical challenges has to do with "pervasive and trustworthy network and services infrastructure." Its content is based on the perception that current network infrastructures, in particular the Internet, is problematic and needs to be replaced soon. The second technical challenge aims at context-aware and easy to use technologies. These are perceived to be a key technology that can further policy objectives in a number of ways. The work programme therefore calls its second main challenge that of "cognitive systems, robotics and interaction." The third and final technical challenge has to do with "electronic components and systems." These are seen to be crucial for the development of the next generation of technologies and therefore as a central basis for further innovation in products and services. It is interesting to note that for all of the three technical challenges the work programme is silent on their expected consequences and link to policy goals. This implies a pervasive belief that technological progress is desirable because of its knock-on effects, the hope that it will lead to successful products, higher competitiveness and thereby to well-being and employment.

The second group of challenges, the socio-economic ones, are more immediately and more visibly linked to the European policy goals. The four challenges meant to address "Europe's socio-economic challenges" are aimed at specific areas where technology is perceived to have a crucial role. The first one is the area of "libraries and digital content". Under this heading, one can find research aimed at digitising libraries and cultural heritage. It also includes a section on technology-enhanced learning and one on intelligent information management. The second challenge addresses issues in relation to sustainable and personalised healthcare. This one is linked to the increasing costs of sophisticated healthcare that are set to further spiral because of the changing European demographics. The challenge is split in three main groups, one on personal health systems, one on patient safety and one on virtual physiological humans, which covers simulations of humans for training and research purposes. The third challenge centres on ICT for mobility, environmental sustainability and energy efficiency. Among the aims here, one can find a range of aims related to efficiency, mobility, environmental protection and distribution of energy. The fourth and final challenge on "ICT for independent living, inclusion and governance specifically" aims at developing applications for ICT related to ageing, accessible and assistive ICT, as well as ICT for governance and policy modelling.

Together these seven challenges represent the applications that the European Commission sees as central to advance its policy agenda. They set the boundaries for the type of research that will be funded under the seventh framework programme. They are therefore likely to have an influence on the technologies that will become viable and wide-spread in the next decade. It is clear that this is not an exclusive list and that there are other development agendas from private organisations, nation states, NGOs etc. that are similarly worth exploring. For our purposes, however, the EU policy is of central interest and we will therefore concentrate on these applications.

Artefacts

While the applications and challenges are relatively easy to identify and list, the same cannot be said for the artefacts envisaged to attain the policy goals. A detailed reading of the Call 4 document displays a range of artefacts that are considered possible solutions to a variety of problems. In addition to physical artefacts, there is a strong emphasis on processes and procedures that may lead to products or services. Rather than try to identify all of the artefacts, this paper will briefly discuss some of the more speculative ones or ones that reoccur as specific artefacts to be emphasised.

The probably most notable such artefact is related to the future of networks and in particular to the Internet. This is the next generation of Internet Protocols, called Internet Protocol version 6 (IPv6). Mentioning of IPv6 reoccurs throughout the document. More importantly, the promotion of IPv6 is named as one of the strategic priorities of European ICT research policy.

In addition to IPv6, the call document goes on to enumerate a number of ICT artefacts that are currently of a rather speculative nature but that are seen as bearers of great potential that deserve to be developed. Interestingly, these artefacts are not linked to the challenges discussed in the preceding section and are therefore not clearly identifiable as contributors to the policy aims. Instead, they form a separate part of the call document, which is listed under the heading of "future and emerging technologies".

Given that the aim of the present paper is to provide a framework for the investigation of ethical issues of emerging technologies, these emerging technologies as outlined by the call document are of particular interest. As they are at a more exploratory stage, their actual conceptual and physical form are currently still uncertain, but the technologies suggested render it clear which way the development is expected to take. The first set of such emerging technologies has to do with high speed data processing and it is listed under "Concurrent Tera-Device Computing." The next set of technologies is based on "quantum information foundations and technologies." "Molecular-scale devices and systems" are suggested as a further important research area. Another predominantly technical area is that of "bio-chemistry-based information technology." The attempt to use cross-disciplinary research in order to improve ICTs is furthermore developed in the "brain-inspired ICT."

In addition to these technical challenges, there are also application-driven emerging technologies. The first one is "human-computer confluence" which explores new modalities for individual and group perception, actions and experience in augmented, virtual spaces. There is also an area of self-awareness in autonomic systems, which aims at an improvement of the interaction between computing artefacts and their environment. Environmental concerns are reflected in the research towards zero-power ICT.

To some degree one can see reflected the distinction between purely technical considerations, which at this stage are not yet application-oriented and those that are specific to particular issues. An interesting question that will guide our further research is whether this more or less specific outcome focus of the artefacts raises particular ethical issues.

Ethical issues

The Seventh Framework Programme (Decision N°1982/2006/EC), Article 6 (1§) states that "All the research activities carried out under the Seventh Framework Programme shall be carried out in compliance with fundamental ethical principles." The same Decision also states later on that "the opinions of the European Group on Ethics in Science and New Technologies [EGE] are and will be taken into account" in research under the Seventh Framework Programme. The emphasis on ethics is based on the recognition of the potential impact of ICT on human rights as established by the European Convention on Human Rights (http://conventions.coe.int/Treaty/en/Treaties/Html/005.htm) and developed by the Charter of Fundamental Rights of the European Union (http://www.europarl.europa.eu/charter/pdf/text_en.pdf). Such general considerations are complemented by other more specific statements, notably the extensive guidelines on addressing ethics included in the guides for applicants for FP7.

Despite this high level recognition of the relevance of ethics to ICT, it is worth exploring in more depth what is meant by ethics in the context of the EU ICT research programme and how it is to be addressed. It is easy to follow the EU policy assumptions that ICT has important ethical aspects and promises solutions to pressing social and ethical issues. At the same time, ICT can raise a host of new ethical questions.

The interesting question for the present paper is how these general ethical concerns are operationalised, and whether there is any guidance on the type of ethical problems that should be considered. There are several documents that offer guidance on how to recognise and address ethical issues. A helpful distinction to categorise different ethical issues is the distinction between ethical issues as arising out of the research process and ethical questions arising from research content. In its "ethical guidelines for undertaking ICT research in FP7" (European Commission, 2008b) the Commission lists a

number of substantive issues that may result from emerging ICT. The first problem identified concerns the autonomy and privacy of potential users. Researchers are reminded that a responsible approach is required and that compliance with European and national legislation is required. Further substantive issues discussed are those connected to specific technologies, such as implants and wearable computing, which have been elaborated by the European Group on Ethics. E-health is seen as a further area worthy of specific warnings as it poses particular problems to privacy and security. The same is true for nano and bio-electronics.

The same concerns that are included in the ethical guidelines are reflected in the Annex 4 of the guidance for applicants, which also forms a part of the proposal form. This annex has the form of a check list that covers informed consent, privacy, and ICT implants. Additional issues that are not further explained are research on human embryos / foetuses, research on animals, research involving developing countries, and dual use of ICT for military or terrorist purposes. The points on this list are further elaborated on in the "Ethics for Researchers" document (ftp://ftp.cordis.europa.eu/pub/fp7/docs/ethics-for-researchers.pdf).

Questions of the social consequences of wide-spread use of particular technologies, which in areas such as e-health could have foreseeable consequences, are not elaborated in much depth. The documentation is quiet, for example, on how one can recognise terrorist applications and how to address such issues. One could argue that such substantive ethical issues of emerging technologies are beyond the scope of concrete current guidance and that this type of issues should therefore be covered by procedures that allow researchers to be alerted to ethical questions. A look at the procedural guidance shows, however, that it is not geared to capturing such issues either. The two main aspects of procedural guidelines are to ensure informed consent and to comply with legislation. Both are well-established ways of dealing with issues arising from the process of doing research. Informed consent in particular is the cornerstone of ethical conduct of medical research. It is open to question, however, whether it is sufficient to deal with ethical issues arising from emerging technologies. It is interesting to note that the guidelines do acknowledge that there are likely to be, hitherto unrecognised, emergent ethical issues resulting from advances in ICT research. Due to the apparent reliance on procedural ethics, it is important to ask which procedures are envisaged in the governance structures of projects.

Governance structures

The most immediately visible aspect of governance has to do with ethics review of projects. Ethical review is described as one aspect undertaken by the panel of experts that undertake the scientific evaluation of a project. The panel of experts will identify a project as requiring special attention if "projects raise sensitive ethical issues or when applicants failed to address ethical issues in an appropriate way." (Ethical Review Procedure, http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=130). All projects thus identified as well as all projects dealing with human intervention or human embryonic stem cells will undergo ethical review. This ethical review will be conducted by a panel of experts and it aims to determine whether the project follows the standards of ethics of FP7. Projects found to be in violation of such fundamental ethical issues are then excluded from funding.

Such external governance of projects is described in some depth, but there is little guidance on internal governance of research projects. There must be some explicit ethical governance, for example in order to ensure that the procedural human research issues, in particular informed consent, are addressed according to standards. This will presumably require some sort of ethics committee but the exact form of such a committee is not clear. Specifically with regards to dual use, the "Ethics for Researchers" document recommends the recruitment of an advisory board, which can advise the project consortium on issues societal, political, and legal aspects of potential applications, on exploitation and dissemination strategies. These ideas are probably valid for other ethical issues. In addition to such external guidance, the "Ethical Guidelines for undertaking ICT research in FP7" state that "activities may, if appropriate, include specific tasks or a specific work package that explicitly addresses ethical concerns (in terms of the research, its conduct and outcomes) and outlines how ethical issues raised by the proposed research will be handled." Further guidance on how such work packages are to be defined, which membership is desirable or how they are to be integrated in the project is not given.

Summary

It is easy to imagine that there are further general categories of relevance to be explored for a better understanding of the ethical issues related to emerging ICTs. For our current purposes of charting a landscape of such ethical issues, the outlined categories offer enough of a differentiation to allow for a detailed picture of issues that can reasonably be expected to develop in the medium term future of 10 to 15 years. Table 1 below summarises the issues enumerated in this section. It is easy to see that there are numerous possible combinations of trends, applications, artefacts, and ethical issues, which allow questions of how they relate to policy aims or which type of governance structure would be likely to be able to address them. This table provides a high level summary of the landscape of emerging ICT ethics and can be used as a basis for further research.

CONCLUSION

This paper aims to provide an overview of current social, political, and technical developments with a view to provide a framework for further research. It has identified current EU policy with regards to ICT research, which will have manifest effects when current research and development projects come to the stage of market entrance, ten to fifteen years from now. To be useful, the framework itself needs to be applied as the basis of further research. However, there are limitations to the current approach. Both points will now be discussed.

Further Research

The framework as summarised in Table 1 will be used as the conceptual basis of empirical research on the realities of current research projects. The conceptual landscape of emerging ICTs in Europe that was developed above is very much a reflection of what policy makers and scholars in leading roles imagine to be desirable and probable futures. A different question is whether and how these aspirations are reflected in current research projects. We will initially concentrate on current ICT research projects of the sixth and seventh framework programme. It is clear that these will reflect the aspirations in their published aims and objectives (otherwise they would not be funded) but it remains to be seen how these are implemented and which consequences are expected. Of particular interest will be whether and how future developments and their ethical evaluation will be considered. This empirical analysis of extant project will then allow us to come to an evaluation of the relevance and accuracy of the above review of the European landscape with a view to developing guidelines for European policy makers on how ethical issues in ICT can and should be addressed.

Limitations

This paper has said nothing about the political processes behind the development of the policy documents. This is academically problematic because a more detailed understanding of these processes would allow for a more comprehensive contextualisation of the issues raised in the different documents. Relying on published documents also presents a more monolithic view of policy objectives and the European ICT research landscape than is likely to be realistic. Policy documents are by their nature contested and express the results of multiple power struggles. This in itself is an interesting issue as power relationships tend to are of ethical relevance. In this case, technologies may be used to promote particular agendas and an uncritical acceptance of existing documents clouds the view of what alternative agendas might have been. This is ethically problematic and also questionable from an epistemological viewpoint as the positions that prevailed in the policy development process may not be the ones that best predict future development and use of ICT.

Trends	Purpose/Policy Aim	Applications/Challenges	Artefacts	Ethical Issues	Governance Structure
ever-increasing computational power plus decreasing size and cost	economic growth	network infrastructure	physical artefacts	research process	external governance
		cognitive systems, robotics	processes and procedures	informed consent legal compliance	
advances enabling new types of interfaces			IPv6	research content	ethical review as part of scientific review
	employment	components, systems, engineering	concurrent terra-device computing	privacy/data protection	
			quantum information foundations and technologies	ICT implants/wearable computing	external advisory board
ability to be connected anywhere, anytime with services on demand		digital libraries and content	bio-chemistry-based information technology	e-health related issues	internal governance
	demographic challenges solutions	healthcare		nano- and bio- electronics	
			human-computer confluence	research on animals	
creation of virtual places, service providers and products		sustainability	self-awareness in autonomous systems	research involving developing countries	work package on ethics
	social/political inclusion	inclusion	molecular-scale devices and systems	research involving human embryos or foetuses	
			brain-inspired ICT	dual use (military or terrorist applications)	informed consent procedures

Table 1: Summary of Emerging EU ICT Research Landscapes.

Despite these shortcomings of the chosen approach, we believe that it can be justified. There are practical reasons for our choice, namely that a more detailed investigation of the political processes behind the published documents would have gone beyond the scope of the research and also of this paper. More importantly, we argue that possible inadequacies of the picture derived at by relying on the documents we used will be borne out during the next stage of the research. It is important to keep in mind that the purpose of this paper is not to give a comprehensive account of what will happen but to develop a conceptual basis for empirical research into existing and planned ICT research projects. The conceptual basis as represented in Table 1will be tested with regards to its reliability and possible inadequacies can be catered for during the next stages of the project. Finally, the European policy framework explicitly states that it focuses on a "limited set of challenges" (European Commission, 2008a, p. 5), namely those which are best suited to fulfil policy aims. By implication this means that there are other challenges that are not considered but which the present research project needs to remain open to if it wants to achieve its goal of understanding emerging ethical issues.

Despite these shortcomings, we believe that the present paper makes a substantial contribution to our understanding of the relationship of ethics and ICT. It provides a framework that can be used to identify a range of different issues whose understanding is crucial for any approach to ethics of ICT that wants to be able to contribute to the solution of expectable problems. We are therefore convinced that this paper is of interest to a diverse audience ranging from software developers and project managers to organisational and political policy makers. While not all aspects of our framework may be completely transferable to other regional and organisational environments, we believe that many of the aspects discussed are likely to be pertinent in emerging technologies and that further research from a variety of backgrounds will be able to build on our findings.

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Note

This paper is part of the research project, *Ethical Issues of Emerging ICT Applications* (ETICA) funded by the European FP7 Science in Society strand.

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Simon Rogerson is Director of the Centre for Computing and Social Responsibility at De Montfort University, UK. He is Europe's first Professor in Computer Ethics. He received the 2000 IFIP Namur Award for outstanding contribution to the creation of awareness of the social implications of ICT. In 2005 he received the prestigious SIGCAS Making a Difference Award by the ACM. Following a successful industrial career where he held managerial posts in the computer field, he now combines research, lecturing and consultancy in the management, organisational and ethical aspects of information and communication technologies. His current research focuses on technological assessment, ethical systems development and qualitative stakeholder analysis. He is co-editor of the Journal of Information, Communication and Ethics and Society. He conceived and co-directs the ETHICOMP conference series on the ethical impacts of ICT and created the world's leading portal on computer ethics.