15. Ethical issues of emerging ICT applications — a Euro-landscape[1]

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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 widespread use. Ethics can then become a tool to clean up a mess that might have been avoidable. It is probably not contentious to say 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 into 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 of 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 chapter aims to contribute to this discussion. Its approach is to identify likely scenarios of future information and communications technology (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 chapter 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 (EU). 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

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ethical issues we can expect and how we may best prepare to meet them. This will lead to policy recommendations for the EU as well as advice for individuals and organisations involved in technology development. The chapter is intended to provide the grounding necessary to develop empirical work. It will develop categories of ICTs and ethical issues that 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 ETICA project, outlined in this chapter, can be described as replacing or complementing the existing feedback ethical analyses which review implemented ICT and consider the reactions of those who are impacted by such ICT. ETICA is a feed-forward approach by which we are trying to provide an ethical direction for future landscapes. In doing so, we hope to reduce the likelihood of ICT which damages individuals, society and the environment and increase the likelihood of real beneficiaries. This is done through establishing policy scaffolding in advance of ICT development and subsequent implementation.

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 chapter. This will start with a description of the seventh framework program. We then outline our concept of ICT ethics. Finally, we discuss some of the policy background that informs the EU'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 chapter.

The seventh framework program for research and technological development (FP7)

The EU has a long tradition of fostering research and development through so-called 'framework programs'. The current seventh framework program (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 (EC) names two main aims of the framework program (European Commission, 2007: 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 program has been divided into four categories: co-operation, ideas, people and capacities. Each of these is then subdivided into further categories and sub-programs. The core of FP7 is the co-operation program, which is used to fund collaborative projects involving partners from at least three European member states. This program has been further divided into 10 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 program aims to support 'frontier research', and funding is based on scientific excellence, without the need for cross-border collaboration. The people program supports researcher mobility across Europe and the capacities program aims to strengthen the research capacities of Europe. This chapter will concentrate on the co-operation program and, more specifically, on its ICT sub-program. 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 program is specifically focused on them. In addition, the ICT program is the largest of all sub-programs 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 program is necessary, given that this chapter aims to investigate the global phenomenon of ethics in ICTs. In addition to the practicalities of this chapter 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 internationally, 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 it is necessary for the EU to set policy that can shape the way technology is designed or used. While this chapter 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 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). The distinction between social norms and their reflection is important to observe, however, 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).

Here, the term 'ICT ethics' is 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. Scholars from different disciplines undertake the different types of investigation. 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, 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; for example, computer law (Poullet, 2004).

Much work in ICT ethics engages with the normative question of how normative problems can be addressed in an ethically sound way. A typical approach that

tends to be taken is the adoption of a behavioural guideline, policy or code (Siau, Nah & Teng, 2002). Some of the most important professional bodies have taken this approach, 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 as they solve (Fairweather, 2000; Ladd, 1985). Alternative forms of governance are, therefore, discussed in this chapter.

The aim of this chapter is not to champion any of the applications or approaches but to develop a framework that captures the 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 chapter. 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 EC. 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 an essential tool in addressing its demographic challenges. In its green paper 'Confronting demographic change: a new solidarity between the generations' (European Commission, 2005), the EC has outlined the challenges the EU is facing. The demographic development continues to be a main area of concern for the EU (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 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. The ICT policies, however, can also be contradictory in other aspects. The inclusion of disadvantaged groups in social processes is an ethically relevant aspiration. At the same time, evidence from the literature on digital divides 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 chapter are consistent.

The first section of the ICT work program 2009 summarises the policy aims behind the EU ICT research initiatives (European Commission, 2008a: 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 chapter 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 chapter was based on a content analysis of a range of sources. Primary among these were documents created by the EU with regard to policy planning, in particular of the seventh framework program. 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', 19 November 2008, with a submission deadline of 1 April 2009 (European Commission, 2008a). This is the document that explains in most detail the aims and objectives of the ICT work program and, thereby, gives an exact view of what European policy makers believe to be desirable and realistic. Further documents are drawn upon where necessary.

Figure 1 represents a higher level view of the relationship among the main concepts that constitute the landscape as derived from the ICT call 4 of FP7. The relationship diagram shows there are at least three views of the derived Euro-landscape: the technology worldview; the technology supplier view and the political view. At least two relationship types exist; drivers (shown as solid arrows) and feedback (shown as chequered arrows). There might be a fourth view, related to user/victim/beneficiary. This fourth view is not easily located in the diagram. It may be better conceptualised to be on a contextual level, which is invisible in this abstract diagram.

In the following subsections we describe the individual categories depicted in the relationship diagram (Figure 1) in more detail.

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. Several general ICT trends can be seen, however, even though the specifics are unpredictable. These trends influence the overall strategic approach, for example, to national and European research funding and to societal acceptance or rejection of technology. John Vaughn (2006: 8–14) 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.

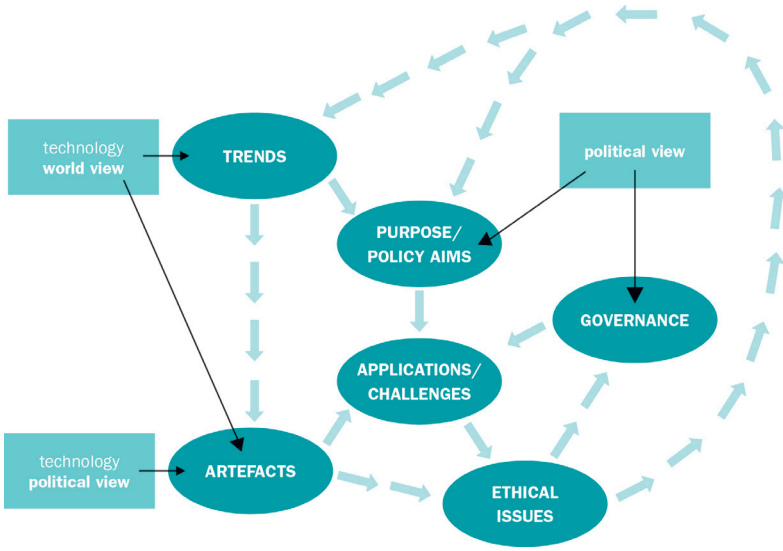

Figure 1: Euro-landscape relationship diagram

Source: Authors' research

- **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 (Strengths, Weaknesses, Opportunities, Threats) analysis and Vaughn (2006) who considers opportunities and barriers. Luciano Floridi 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' (2007). If this is the case, then the ethical dimension of ICT becomes the ethical dimension of society per se.

Applications and challenges

In this chapter 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 can be plausibly made. 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. Artefacts can usually, however, 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 that 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 program, 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 wellbeing 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 EC 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 program. They are therefore likely to have an influence on the technologies that will become viable and widespread in the next decade. It is clear that this is not an exclusive list and that there are other development agendas from private organisations, such as nation states or NGOs, 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 that are 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 chapter will briefly discuss some of the more speculative ones or ones that recur as specific artefacts to be emphasised.

The most notable of such artefact is related to the future of networks and, in particular, the Internet. This is the next generation of Internet protocols, 'Internet protocol version 6 (IPv6)'. Mentioning of IPv6 recurs 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 speculative, 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 chapter is to provide a framework for the investigation of ethical issues of emerging technologies, these emerging technologies are of particular interest. As they are at a more exploratory stage, their 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 terra-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, 'human-computer confluence', 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 program (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 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 eventh 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, which are 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 program 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 chapter 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 EC lists a number of substantive issues that may result from emerging ICT. The first problem 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 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 annex 4 of the guidance for applicants, which also forms a part of the proposal form. This annex is a checklist that covers informed consent, privacy, and ICT implants. Additional issues, which 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 elaborated in the 'Ethics for researchers' document (<ftp://ftp.cordis.europa.eu/pub/fp7/docs/ethics-for-researchers.pdf>).

Questions of the social consequences of widespread use of particular technologies, which, in areas such as e-health, could have foreseeable consequences, are not elaborated. The documentation does not address, for example, 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 and 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 that are 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 societal, political, and legal aspects of potential applications, on exploitation and dissemination strategies. 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.

Table 1: Summary of emerging EU ICT research landscapes

Trends	Purpose/policy aim	Applications/ challenges	Artefacts	Ethical issues	Governance structure
Ever-increasing computational power plus decreasing size and cost Advances enabling new types of interfaces Ability to be connected anywhere, anytime with services on demand Creation of virtual places, service providers and products	Economic growth Employment Demographic challenges solutions Social/political inclusion	Network infrastructure Cognitive systems, robotics Components, systems, engineering Digital libraries and content Healthcare Sustainability Inclusion	Physical artefacts Processes and procedures IPv6 Concurrent terra-device computing Quantum information foundations and technologies Bio-chemistry-based information technology Human–computer confluence Self-awareness in autonomous systems molecular-scale devices and systems Brain-inspired ICT	Research process Informed consent legal compliance Research content Privacy/data protection ICT implants/wearable computing E-health related issues Nano- and bio-electronics Research on animals Research involving developing countries Research involving human embryos or foetuses Dual use (military or terrorist applications)	External governance Ethical review as part of scientific review External advisory board Internal governance Work package on ethics Informed consent procedures

Source: Authors' research

Conclusion

This chapter 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, 10 to 15 years from now. To be useful, the framework itself needs to be expanded and applied as the basis of further research.

This chapter draws on a particular document from a particular source to identify relevant concepts that allow us to understand which emerging ICTs we can expect and which ethical issues these may raise.

It is, therefore, beyond question that, in order to come to a better understanding of the subject area, a richer understanding of the field is required. This is true with regards to the identification of emerging ICTs, and probably even more so with regards to ethical issues. Ethics in real life is always a question of context and situation, which general descriptions cannot capture. This leads to the question of how such contexts can be incorporated. The answer decided upon by the ETICA consortium is that it can only be done as a second step, once a general understanding of the landscape of emerging ICT has been gained. The reason for this decision to concentrate on the abstract first is that a consideration of substantive ethical issues at an early stage is epistemologically impossible and practically infeasible. The epistemological issue arises from the fact that any technology can be applied in an infinity of context, some foreseen, most not. In each of these contexts the technology may raise a number of different ethical issues. It is thus not possible to give a representative overview of these issues. A more abstract level of analysis is therefore required before more detailed cases can be subjected to analysis.

This approach does, however, raise new issues. Primary among them is the question of how a general understanding of emerging ICTs and their ethical issues can be developed. The approach chosen by the ETICA consortium in order to address this question is to do an analysis of a number of sources that focus on high-level visions of emerging technologies. The EU FP7 ICT call analysed here is one example of such visionary documents but, in order to have a more representative understanding, further documents will need to be included. These will include other European documents but also policy documents from other areas of the world; for example, the United States, Australia and Japan. The justification of the choice of such high-level views is that, collectively, they are likely to give a good understanding of what the political leaders of

this world envisage as future technologies. Such a vision is likely to influence factual developments through the means of research funding and legislative developments.

At the same time, an understanding of what is expected to happen in actual research should be sought via an analysis of the vision documents produced by leading research institutions around the globe. Such institutions, in many cases, have mission statements or comparable documents that give an insight into the type of technologies on which they are working, which gives a view of what is likely to become reality in the medium-term future.

The sources of the ETICA data analysis can thus be represented as follows:

Figure 2: Delimitation of data sources

Source: Authors' research

The delimitation of data sources, as suggested in Figure 2 is justified by the fact it will give a good view of what is intended and envisaged by organisations that are in a position to enforce their view of the world. It should not be misunderstood as aiming at a true or verifiable prediction of the future. As with any future-oriented research, this project is not able to do this under any circumstance. What it can do is aim to provide plausible possible futures to enrich discourses concerning desirable futures and possible ways to get there. In order to spawn such discourses, one needs to give thought to what aspects of the sources to analyse and in what way, so that the outcome of analysis is of relevance and produces novel insights.

The decision to concentrate on documents to investigate which technologies are emerging and which ethical issues can be expected betrays a constructivist assumption of the project. Technology is not a neutral and independently existing entity but it gains meaning through the medium of discourses. Analysing such discourses can, therefore, help to understand the formation of the meaning of technologies. At the same time, there is a potential infinity of emerging technologies and their applications.

It was, therefore, decided to follow the phenomenological idea of identifying the essences of phenomena. This essence is then going to be subjected to an ethical analysis. The immediate question following this statement is going to be: how do we identify the essence of an emerging technology? The answer, from the point of view of a researcher interested in emerging ICTs and ethics, is that the essence of the technology is the way in which it changes the world and the relationship of humans to the world. Central questions to be asked of texts, therefore, include the way the technology is represented in the text, which includes sub-questions of the expected social impact, the representation of society, social values and anthropological views elaborated in the text. Of similar interest are critical issues; that is, social, legal or ethical issues outlined in the text. To avoid falling into the trap of either social or technological determinism, not only the social representation of the technology will be covered but also the artefacts that it produces; that is, its technical constraints or capabilities. These aspects will be collected together with higher level categories, such as fields of technology, target audiences, fields of application and, wherever possible, application examples. In addition, metadata on the sources will be collected.

As a result of this, a grid of analysis will be developed that will allow an analysis of a rich field of emerging technologies, which can be analysed from a variety of perspectives. Once the analysis is finished, it will, for example, be possible to compare predicted technologies on the basis of the type of source they are derived from, or investigate whether particular types of application lead to particular types of predicted critical issues. The analytical grid will lend itself to a relatively simple input of further data; for example, from surveys from project coordinators. The analytical grid will contain sufficient information to allow a normative ethical analysis of particular technologies. And, finally, it can be used to determine whether interesting clusters of technologies, issues, or descriptions emerge that warrant further attention. In this way the analysis will allow a targeted description of emerging ICTs, a sound linkage of these technologies with ethical issues and a justified basis for policy advice.

The earlier analysis of a particular policy document has thus shown how relevant categories of analysis can be distilled from an existing source. The categories enumerated here (see Table 1) are not identical to the categories of

analysis enumerated in this section, but they are encouragingly similar. As a result, the exercise shows that it is reasonable to expect to find information on the relevant categories in policy-related documents.

The current chapter therefore provides a good starting point of further data collection and analysis, provides a sample of such analysis and shows how further research can proceed. As a result, the ETICA project will be able to produce findings that go beyond restating the obvious without falling into the trap of unjustified concreteness in the light of an unknowable future. It will give an indication of possible futures and thereby contribute to the aim of allowing a more proactive feed-forward approach to ICT policy.

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