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The Social Embeddedness of Embedded Networked Sensing

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New Approaches to Research on the Social Implications of Emerging Technologies

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These position papers are intended to support and facilitate discussion at the MIT–OII Joint Workshop *New Approaches to Research on the Social Implications of Emerging Technologies* to be held on 15 and 16 April, 2005. They may be one of the sources of a possible OII Discussion Paper based on the Workshop, to be posted on www.oii.ox.ac.uk

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Living Labs: or User-Driven Innovation Environments in the 'Information Society'

Jan Annerstedt

Don't bite my finger, look where I am pointing!

This draft position paper is about user-driven innovation with regard to (mobile applications of) information and communications technology. How to foster and manage innovation environments that allow for users to help create new applications, and, also, how to side with high-tech firms, R&D centers, universities, business fims and supporting institutions in processes of invention, prototyping and design of computer software as well as physical products?

One response to these questions could be to point at the frequent use of full-scale test beds located across Europe. Some of these test beds have become so-called Living Labs. A Living Lab is a city area that operates as a real-time urban laboratory and proving ground for prototyping and testing new technology applications. A Living Lab should be managed beyond the test bed function. Ideally, it should foster new means and methods for generating inventiveness among users, help sustain innovation processes and mobilize entrepreneurship to create new ventures in business and society.

While working on his 2005 book *Democratizing Innovation*, Eric von Hippel found that users' abilities to develop new, high-quality products and services for themselves are getting enhanced radically and rapidly.

> Steady improvements in computer software and hardware are making it possible to develop increasingly capable and steadily cheaper tools for innovation that require less and less skill and training to use. In addition, improving tools for communication are making it easier for user innovators to gain access to the rich libraries of modifiable innovations and innovation components that have been placed into the public domain. The net result is that rates of user innovation will increase even if users' heterogeneity of need and willingness to pay for 'exactly right' products remain constant.[1]

Information technology change and innovation communities

Who needs local, user-driven innovation environments, when there seems to be a steady flow of new products from globally operating business firms? Why make a case for Living Labs, where users are key players, when producers typically are in lead positions, trying hard to shape the impact of today's information and communication technology?

Well, these questions do not really consider where many of today's 'Information Society' technologies and applications are actually generated. We must not forget ground-breaking applications, driven and shaped by user-needs, such as those of Linux and the Open Source movement! The phenomenon of user-driven and user-centric innovation with regard to 'Information Society' technologies is becoming a general phenomenon across Europe and in some other parts of the world. This phenomenon is growing rapidly, so it seems, along with

[1] Hippel, E.v. (2005) Democratizing Innovation. Cambridge, MA: MIT Press, p. 121.

advances in computing and communications. Eric von Hippel claims[2] that user-centric innovation is becoming both an important rival to and an important feedstock for manufacturer-centered innovation in many fields. One such dualism: (i) being user-driven and, at the same time, (ii) becoming increasingly important for relatively less inventive corporations, is exploited by the inventors and organizers of Living Labs. Users (especially 'lead users') and user communities are gradually attaining more substantial roles as true inventors and entrepreneurs. On the other hand, corporations—particularly engineering and manufacturing firms—tap into the locally-anchored innovation processes to transform pioneering products into mass market produce.

The innovation communities could be wide in their range of activities, or they could be highly specialized, serving as collection points or repositories of information related to certain categories of technologies or innovations.[3]

Ideally, a Living Lab is made up of individuals and interconnected firms, institutions and other organizations. They interact by face-to-face and by electronic and other means of information and knowledge transfer. However, to be successful they may not need to incorporate all the qualities of a community of interpersonal ties that would 'provide sociability, support, information, a sense of belonging, and social identity',[4] even if this could make a Living Lab even more effective.

Local nodes in global networks

Judging from current Living Labs experiences (see below), when the Living Labs are perceived as local innovation environments or innovation communities, they actually do flourish when at least some actors in them continue to innovate and voluntarily share their insights and reveal parts of their innovations. The Living Lab becomes even more dynamic and may also become an effective hub or transaction point in a wider network, if others find the information revealed of special importance to them as inventors and entrepreneurs.

Typically, in recent years, the capability and the information needed to innovate effectively are becoming widely distributed. The most effective Living Labs are designed for many types of users and implemented as local nodes within European and even global networks. From an overall policy-point of view, the

> traditional pattern of concentrating innovation-support resources on just a few pre-selected potential innovators is hugely inefficient. High-cost resources for innovation support cannot be allocated to 'the right people', because one does not know who they are until they develop an important innovation. When the cost of high-quality resources for design and prototyping becomes very low—which is the trend … —these resources can be diffused widely, and the allocation problem then diminishes in significance. The net result is and will be to democratize the opportunity to create.[5]

[2] Hippel, E.v.: Democratizing Innovation. The evolving phenomenon of user innovation. Cambridge, MA: MIT, unpublished paper, 26 pp.

[3] Above n 1 at p. 95.

[4] Wellman, B., Boase, J. and Chen, W. (2002) The Networked Nature of Community On and Off the Internet. Working paper, Centre for Urban and Community Studies, University of Toronto, p. 4.

[5] Above n 1 at p. 123.

Leaps in technology—and in our cognitive competencies

Information and communication technology could be powerful tools for our minds. Yet, while the technological capacities to store enormous amounts of data continue to increase and the capabilities to access and process data by technical means are amplified, our cognitive abilities do not always appear to improve by the same speed.

Less and less, the limitations of access to data and processing of data are technological and economic (the costs for data storage are approaching zero). More and more, the real boundaries for transforming data to information and knowledge rest in our minds. If our mindsets develop slowly in relation to the new technological means in our hands, the conditions for creating and shaping innovations may be profoundly affected.

'Democratized' innovation or not, we may in fact be slow to detect the many new qualities of what the European Commission prefers to call the emerging European 'Information Society'.[6]

Why this thing called Living Lab?

Given the waves of technological change due to the information and communications technology of our generation, how to really create optimal conditions for shaping the technology applications to fit user needs and related organizational, social and cognitive changes? And, how to provide the resources for an innovation environment that is well adapted to 'democratized' opportunities to create?

As a managed innovation environment, a Living Lab is a city area that operates as a full-scale urban laboratory and proving ground for prototyping and testing new technology application and new methods of generating and fostering innovation processes in real time. Users, including professional users, should play a significant role in identifying needs, shaping applications, and creating effective interactions between the inventive producers and users of technology for truly inventive uses.

Living Labs that already operate, or are starting to prepare operations in various European cities, typically focus on original applications of information and communications technology and other such 'Information Society' technologies. Currently, Living Labs initiatives have been taken by groups of stakeholders in cities like Almere (the Netherlands), Barcelona (Spain), Copenhagen (Denmark), Gothenburg (Sweden), Helsinki (Finland), London (United Kingdom), Luleå-Boden (Sweden), Mataro (Spain), San Cugat (Spain), Sophia-Antipolis (France), Stockholm (Sweden), Tallinn (Estonia), Torino (Italy), and Västervik (Sweden).

Each Living Lab organization should include a commitment by a stakeholder group, have a management team, operate as a self-funding center (company, foundation, etc.) and sign an agreement based on the principle of sharing Living Lab experiences and practices across Europe.

What's Living Labs Europe™?

Living Labs Europe™ is a cross-border inter-city organization in Europe, currently coordinated by Interlace-Invent (Ltd.), a research-based consultancy firm in Copenhagen with operations

[6] When we talk about the 'Information Society' and a more knowledge-intensive economy, we often forget that the conventional indicators of invention, innovation and other change seldom depict conceptual and other cognitive changes among individuals and among firms, institutions and other organizations. We need to apply more adequate indicators to reflect advancements in the 'intellectual capital' of an institution or in the 'intangible goods and capabilities' of a business firm.

across Europe. Living Labs Europe™ is managed as a consortium of innovative city-based projects across the European continent, pioneering advanced applications, shaping purposeful uses of leading-edge mobile information and communications technology. Each Living Lab agrees to be a node in a European network and share information and experiences and, if possible, develop cross-border projects with other Living Labs.

A Living Lab project should be competitive and global in orientation, yet locally anchored. It should be interactive in all its workings, involving advanced users as well as producers of technology and applications. Typically, a Living Lab project is to be supported jointly by individuals, business firms, public sector agencies and research institutions.

Who shaped the Living Lab Europe™ concept?

Today, the Living Lab Europe™ concept and its implementation strategies have a ten-year history. During 2003, in cooperation with Nokia and some other brand name companies, the concept of Living Labs was tried out while preparing a Europe-wide research consortium focused on mobile individuals and the urban environment that may influence new work practices and life styles. Interlace was the coordinator of the Living Lab effort that became a central element in the overall project design, receiving inputs from private sector and public sectors stakeholders alike. In various formats, the Living Lab concept had already been tried in various Nordic cities.

Six years ago, in 1999, Interlace-related experts were involved in creating a generic design for a city-based innovation resource that takes advantage of regional pools of creative talent, the affluence of cultural diversity, and the unpredictability of imagination in the urban setting. The focus at the time was advanced applications and professional use of information and communications technology, combined with research and development in the cognitive sciences and related fields of specialized competencies.

The first practical application of what was to become a full-scale Living Lab was a square km site in the center of Copenhagen, 10–15 minutes drive from the international airport. The platform of support to innovation was established a year after and included a consortium of collaborating firms (Nokia, CSC, HP, Skanska, etc.), public institutions (Denmark's broadcasting system (DR), the Consumer Information Board, the National Archive, the National Library, etc.), and R&D and higher education institutions (Copenhagen University, the IT University of Copenhagen, etc.). This 'triple helix' of cross-sectoral collaboration formed the Örestad Nord Group.

The moving force in the Örestad Nord Group remained to be a shared research and development portfolio of projects evolving over time. Each consortium member has to be engaged in at least one joint project among optional projects generated in the Living Lab area. The ideal project should include leading-edge users as well as advanced producers of applications that could match the user needs. The projects are facilitated by a management team that operates within a company, owned by the consortium, and called Crossroads Copenhagen (www.crossroadscopenhagen.com).

In short, based on the Örestad Nord platform, Crossroads Copenhagen is the professional setup to help generate world-class projects and shape them all as forward-looking and sustainable while also diffusing results. The Crossroads management also advises on property rights issues and initiates activities that will involve players outside of the Örestad Nord area of Copenhagen. Several of the Crossroads Copenhagen projects achieve success also through the world-class, seamless information and communications infrastructure that is being offered in the area.

Apart from Crossroads Copenhagen, six Living Labs have emerged (or are still coming about) among the Nordic countries. There are three metropolitan efforts: Helsinki (Arabienranta), Stockholm (Kista), and Göteborg (Norra Älvstranden). There are three mid-sized city efforts: M-City Tallinn (Estonia), Baltic Crossroads (Västervik), and Internet Bay (Luleå-Boden).

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Social Implications of Emerging Technologies

Walter S. Baer

Information and communications technologies (ICTs) generally 'emerge' after years of continuing incremental improvements in their performance, cost, and usability that increase demand for them and lead to their widespread adoption. Social implications follow, and network effects can accelerate both adoption and social impacts. On the other hand, social implications may change with familiarity and widespread use. For example, most people thought it rude to encounter a telephone answering machine when they were first introduced in the 1970s. Twenty years later, it was considered rude not to have a machine respond when a person didn't pick up a call.

We have some ability to forecast technical improvements (e.g., Moore's Law and its derivatives), but considerably less success in forecasting demand, particularly demand for new uses or applications. Demand for satellite telephones was greatly overestimated in the 1980s and 1990s, while demand for terrestrial cell phones was underestimated. Civilian demand for personal GPS devices received little attention before the 1991 Gulf War, even though GPS technology had been under development for more than two decades.

Unintended consequences often dominate the social implications of emerging technologies. We might want to spend some time at the Workshop reflecting on the unexpected or unintended consequences of ICTs over the past 20 years, such as spam, P2P file sharing, and improved cognitive performance (e.g., hand–eye coordination) among military pilots who grew up playing video games. At what stage were these first predicted or discussed? When were they taken seriously? What lessons can be drawn for future research and analysis?

Revisiting Technology Assessment

The Technology Assessment movement of a generation ago sought to identify and evaluate the social implications of technological change. Technology assessments were forward looking, often trying to forecast the secondary and tertiary consequences of adopting a new technology. But in a 'retrospective technology assessment' entitled *Forecasting the Telephone* (Ablex, 1983), Ithiel Pool characterized, reviewed, and analyzed 186 forecasts made between 1886 and 1940 about the social impacts of the telephone. It makes fascinating and relevant background reading for this Workshop.

Following Pool's example, would it be worthwhile to review, in hindsight, forecasts of social impacts of ICTs that have had significant adoption in the past 20 years, such as:

- Mobile phones
- Email
- Video games
- Word processing software
- GPS
- Surveillance cameras in public and commercial spaces
- Weblogs

Such retrospective assessments would focus on the methods, data, and outcomes of prior forecasts, with the objective of informing future research and analysis on the social implications of emerging technologies. A more ambitious project would be to conduct a retrospective meta-analysis of the more than fifty ICT assessments conducted by the Office of Technology Assessment, an arm of the US Congress, between 1974 and 1995.

Cell phones and cars as mobile, locatable sensor platforms and networks

GPS receivers are being built into automobiles and cell phones/PDAs for emergency location, map reading, and (for now) commercial vehicle tracking. Location data can and will be integrated with data from cameras and other embedded sensors. Within a few years, we are likely to have hundreds of millions of locatable vehicles and phones in North America, Europe and Asia that serve as mobile, networked, *ad hoc* sensor platforms.

What new uses will emerge from these capabilities? Applications already being used at small scale, being tested, or under discussion include:

- Emergency alerts; e.g., automated tsunami or tornado warnings to phones and cars in threatened areas
- Commercial alerts for nearby products and services
- Alerts that friends or other specified people are nearby, often followed by voice or IM communication (e.g., www.dodgeball.com/social/)
- Accident alerts that automatically call 911 if a vehicle suddenly decelerates
- Driver monitoring, using 'black boxes' that record vehicle speed, acceleration, and braking (of interest to parents, insurance companies, car rental agencies, and law enforcement agencies, among others)
- Pervasive vehicle tracking, with or without the driver's consent (e.g., for vehicle usage-based fees or taxes to support roads and other infrastructure)
- Phone tracking, with or without the phone user's consent
- Weather monitoring to provide dynamic, micro-scale reports and forecasts
- Dynamic monitoring of pollutants, hazardous chemicals and bio-materials

History tells us that other, as yet unforeseen, applications that integrate location and other sensor data will likely have even more important commercial and social implications.

Given the obvious privacy implications of widespread GPS use, should policymakers consider measures now to protect individual privacy, such as:

- Requiring that cell phones give users full control over location reporting, except for emergency calls and other specified situations?
- Giving drivers control over location reporting by their personal vehicles, except for emergencies and other specified situations?
- Requiring vehicles to display to the driver when location and/or other data are being reported?
- Explicitly authorizing the use of short-range GPS jamming devices?

I think this is a good technology to focus on because it is developing rapidly but has received relatively little attention, has potentially large economic and social implications (including likely unintended consequences), threatens established rules and social norms, and appears to have data and other information available for research and policy analysis.

Social impacts of automated personalization and social networks

Individually tailored advertisements, product and service recommendations, news, invitations to social and other events, and personal introductions on the Internet are steadily growing in popularity, particularly among young people. So are social networks such as Friendster, Tribe, Friends in the City, Orkut, Meetup, and Linkedin that connect friends-of-friends or other like-minded individuals. These trends are supported by continuously improving personalization and social software, as well as pervasive communications.

These developments seem sure to have important social implications that are worth discussing at the Workshop. Topics and questions include:

- What are the important dimensions of social consequences that should be examined in the context of personalization and social networks?
- How well does existing social network theory describe what is happening on the Internet? In what ways do social networks in cyberspace operate differently from those in physical space?
- To what extent can controlled experiments shed light on likely social consequences; e.g., experiments planned by The SocialPhysics Initiative at the Berkman Center 'in such issues as privacy, authentication, reputation, transparency, trust building and information exchange?'
- What may be the economic and institutional consequences of automated editing and personalization of news and information? For a provocative scenario about news and information in 2014, see www.robinsloan.com/epic/

Personalized Digital Services: Power, Equity and Transparency in 'Digital Familiars'

An exploration of the issues of personalization and customization

Jason Black, Kieran Downes, Frank Field and Aleksandra Mozdzanowska

(a working draft with links, etc. is available at *https://msl1.mit.edu/twiki/bin/view/Scratch/PersCustWorkingDraft3*)

> ARIEL
> All hail, great master! grave sir, hail! I come
> To answer thy best pleasure; be't to fly,
> To swim, to dive into the fire, to ride
> On the curl'd clouds, to thy strong bidding task
> Ariel and all his quality.
>
> *The Tempest* Act I, Scene II; William Shakespeare

As computers and computerized services have become ubiquitous, there has been a concomitant increase in the mechanisms and modalities of personal interaction with these devices. However, the accessibility and understandability of the services being offered has continued to outstrip the public's grasp of the possibilities of these technologies.

One strategy that has been employed to ease the human–machine service interaction has been to shift the burden of understanding the operation and/or capabilities of a machine service away from the user and onto the programmer. By devising software interfaces that adaptively respond to signals from the user, the programmer can embed program facilities that can 'learn', identifying limitations in the user's appreciation of the operation or the features of the machine service being provided and attempting to anticipate the user's needs and wants without the user having to master the machine or system.

These efforts to create adaptive interfaces have gone through many iterations, and have seen varying degrees of success. As the computer has become more and more ubiquitous, these adaptive interfaces have become a part of the daily lives of the public.

One of the main streams of this kind of system design goes under the names of 'personalization' and 'customization', largely distinguished from one another by the extent to which the user actively participates in shaping the performance and behavior of the software intermediary. While these tools are descendents of the original efforts to simplify the user's experience with complex software services, as their application has moved from the specialized to the mundane, a host of important issues have begun to emerge.

A brief historical exploration of a handful of the current exponents of this set of technologies can serve to illustrate the nature of these issues. Personalization's preeminent exemplar is Amazon.com, where a web-based software agent acts as the customer's personal shopper. Based upon the customer's purchasing history, and the purchasing history of all other Amazon.com shoppers, the software makes purchasing suggestions, leading the customer to what they expect are products that are likely to satisfy their wants. The user has the option to actively participate in 'teaching' the software by ranking past purchases and commenting upon products purchased elsewhere, but the fundamental effort has been to mimic the

behavior of an attentive salesman, who has a perfect memory and a firm grasp on the interests and buying habits of all of Amazon.com's customers.

At one level, there is nothing new about this kind of marketing, of course. While the field has gone through a host of incarnations, at its heart marketing has been about identifying what a customer has bought in the past, and drawing inferences about that to promote new purchasing options. Probably the key development in marketing has been the discovery that, sometimes, it is more effective to promote the seller/producer of the product than the product itself—leading to the rise of the notion of 'brand' and its marketing. And the focus of that effort is the development of 'brand trust'—the sense that, even if the customer does not know everything about the product offered, the fact that it is being offered by a company that the consumer has good feelings about is enough to close the sale.

Customization, where the user takes an active role in shaping the interaction with the machine service, has also moved into areas beyond software system interaction. For example, the delivery of news and other time-sensitive information is increasingly being offered through the agent of a computer-driven site that sift the news data stream according to criteria set by the user. Whether delivered by pull (e.g., web-based) or push (e.g., email newsletters) technologies, the user can instruct the server, within a range of choices set by the programming, to classify and deliver information according to those classifications.

Again, in certain respects, nothing new here. News gathering and delivery strategies have evolved over hundreds of years, including coffee shops and taverns that specialized as collection points of certain kinds of information, diverse newspapers and news magazines focusing upon specific content or editorial positions, and various kinds of broadcast services whose content and delivery might commonly be shaped by the technologies employed and the strictures set by public policy.

The software industry has continued, of course, to work to refine the agents that act to improve the usability of their own products, seeking to increase the utility of (and, thus, the demand for) their products. Yet, it appears that there are limits to their abilities to accomplish this on the scale of the individual. The ubiquitous Microsoft Office family of tools is rife with instruments that actively seek to help the user. Auto-correction of typographic errors in Microsoft Word has been a boon to many—except when the software insists on making a change that the user does not want. Microsoft's Office Assistant ('Clippy', almost certainly an application of the ill-fated 'Microsoft Bob' technology) has seen massive investment, only to be side-stepped owing to the virulent hatred that it has engendered in a sizable fraction of the population the tool was expected to service.

The potential of this family of technological developments is huge. As our tools for collecting, manipulating and acting upon information become more capable, they have also tended to become more complex, limiting their accessibility to those who might benefit most from their use. The introduction of the notion of a software-driven mediator between the user and the service that is programmed to adapt to the user's strengths, limitations and revealed preferences is a clever approach to the problem, and proponents claim it has led to substantially more penetration of these services than might otherwise be expected. However, as these tools have migrated from the land of pure software and into the realm of information services more generally, there are reasons to inquire into how these 'digital familiars' change the conventional into something less so.

Rather than 'agent', the notion of a 'familiar' seems a more apt term in this context. As with Prospero's Ariel, the familiar is an agent of the magician/user, and its talents in channeling magical forces helps the user to achieve his ends. However, the familiar does not slavishly hew to the user's will, but is instead an independent agent whose motives are not necessarily aligned with the user's.

For both of the non-software examples, sales/marketing and information/news gathering, the notion of 'trust' emerges as a key element of the activity. In the case of sales, the goals of the sales agent is to develop a trust relationship with the consumer, so that she will be willing to make a purchase that will leave both the salesman and the consumer better off. In the case of

news/information gathering, the issue of trust arises through the notion of the authority of the information source—can the information be 'trusted?'

For both sales/marketing and news/information, society has seen the need to erect institutions to ensure equitable and transparent relationships in these transactions, particularly as the scale of the services has increased. Fair trade, truth in advertising, 'fair and balanced' news—these are public policy goals that have emerged in the face of increasing concentrations of power on the side of the service providers, particularly as these interactions have moved from the personal to the corporate/industrial.

The 'digital familiar' is presented to the consumer as an electronic servant. The attentive salesman, the easily-directed news clipping service and the host of complements being deployed today extend the abilities of the user/consumer in a host of exciting and innovative ways. But their introduction into daily life also raises a set of issues that, if addressed at all, is being handled without a complete consideration of their scope.

Fundamentally, the key issue is that, although the 'digital familiar' poses as the servant of the consumer, the consumer is not the master of the familiar—either personalized or customized. While the familiar can mimic the development of a relationship, no such relationship is actually forming. Rather, the familiar is seeking to engender trust, without the reciprocal responsibilities that are a part of normal relationships.

As a consequence, the familiar is perfectly capable of sharing queries, information, analyses, and assumptions about the user that would be considered gross invasions and betrayals in the real world. Information divulged to a friend is constrained by the relationship, trust and social mores; the 'digital familiar' may build upon those cultural assumptions, but it is not constrained by them. Moreover, the familiar, armed with an appreciation of the user that is developed through inhumanly attentive collection and analysis of user behavior, is positioned not merely to serve, but also to shape (if not control) the actions of a user whose whole relationship with the familiar is founded upon his/her relative ignorance of the familiar's true capabilities and inner workings.

Already the information collection, organization and reselling business has grown to a scale that has raised concerns among public interest groups and activists. As 'digital familiars' become an ever-increasing part of the way in which users interact with the world around them, it is going to be vitally important that there be an exploration of the ways in which the gaps that these tools exploit can be filled, either through the expansion of current institutions of management and control, or the development of new ones. And, increasing attention will have to be paid to exposing the interests and enforcing the responsibilities of the men 'behind the curtain' who are financing the programming of these familiars.

Otherwise, when the public finds out the extent to which the 'servants' have been talking behind their backs to characters they deem unsavory, their reaction may lead to the crippling not only of this area of innovation, but many others in digital communications.

Open Issues/Questions

1. Relationships

    (a) Is forming a relationship with a computer program the right working metaphor for constructing a familiar? A healthy one?

    (b) What are the pitfalls of constructing a 'cutout' in a relationship, particularly when the cutout is under the (complete) control of one party? What are the implications of increasingly substituting digital, software-based intermediaries for traditional interactions?

2. Trust

(a) A chain of trust—The development of digital familiars creates a complex chain of relationships and dependencies, with many actors working to refine their own piece of the problem. Does this increase or decrease the stability of the trust relationships? The design objectives? What about other social objectives—responsibility, liability, monitoring?

(b) How might liability and other forms of obligation and responsibility be assigned along this 'chain of trust?' What institutions exist already to service these requirements (contracts, product liability, etc.)? What failures need to be addressed?

(c) What might be learned from other domains where trust/reputation are key elements, yet complexly derived through indirect and direct interactions—e.g., academia, scientific research? (How to interpret the list of authors on an academic paper, for example).

3. 'Where is the brain?' (From *Harry Potter and the Chamber of Secrets*: 'Never trust anything that can think for itself if you can't see where it keeps its brain')

(a) Who's really in charge: (i) the algorithm, or (ii) the data collected to drive the algorithm, or (iii) someone else?

(b) The locus of power in expert/client relationships has evolved over time. What are the underlying assumptions, and how has the introduction of these sorts of technologies changed them? Have the institutions that have grown up around those assumptions changed along with them?

4. What's the nature of the 'harm' that worries those who consider these technologies now?

(a) Direct 'harms' might include price discrimination, sales of one's information (privacy), manipulation into doing things one might otherwise not do.

(b) Indirect 'harms' may include 'cocooning,' the elimination of diversity through the creation of an 'echo chamber', a world shaped to reflect the individual's view rather than reflecting reality.

5. What does concentration in the ownership and application of these technologies do to shape the concerns? Would ubiquity and universal access change the problems, or just change the emphasis?

6. Does the fact that most creators of these technologies are commercial, rather than governmental, moderate these concerns? Should it? Do pernicious uses by commercial or governmental entities present the greatest long term threats?

7. Familiars

(a) Fundamental technical question—how far can one go with this technology?

(i) What limits its effectiveness today? Are there efforts to tackle these limits now, or is the field focusing on other issues?

(ii) What are the limits on data mining? What are the boundaries of the field today?

(iii) What about our understanding of human cognition in this domain? How sophisticated is our ability to direct or induce conscious and unconscious responses? To condition?

(b) What constitutes effectiveness in this application? How do the alternative strategies (active vs passive, visible vs invisible) influence this?

(c) How to balance the benefits of mimicking real world relationships against the issues raised in the paper. Is it worth it?

The Social Embeddedness of Embedded Networked Sensing

Christine L. Borgman

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While embedded network sensing technology usually is framed in terms of 'Embedding the Physical World' (http://www.engineeringalum.ucla.edu/CENS/CENS.htm), these technologies are equally embedded in the social world. The technology is best understood as a system rather than as individual discrete sensors. UCLA's Center for Embedded Networked Sensing (CENS), which is one of six National Science Foundation Science and Technology Centers established in 2002, uses the slogan 'the network is the sensor'. These are large-scale, distributed systems, composed of smart wireless sensors and actuators embedded in the physical world, intended eventually to connect the entire physical world to the virtual world (http://www.cens.ucla.edu).

Social consequences of these systems are framed initially in terms of the scientific value, such as monitoring, assessing and reducing exposure to contaminants in soil and air, or engineering value, such as monitoring and assessing the stability of structures such as buildings and airplane wings (examples from CENS).

Ethical, Legal, and Social Issues

Some of the ethical, legal, and social implications were recognized early in the emergence of these technologies. An example much discussed in the first two years of CENS is radio-frequency identification tags. RFID is being deployed widely for inventory tracking in retail operations, especially for the vertical integration of the supply chain for companies such as Walmart. Although scanning boxes as a quick means to inventory contents may seem harmless at first, those tags remain in individual items of consumer goods, including clothing. In theory, individuals could be identified in public based on signals being broadcast from tags in their shirts or slacks. Dana Cuff, professor of architecture at UCLA, is studying how RFID and other sensing technologies could change the concept of 'public space'.

RFID technologies also are beginning to replace bar codes for inventory control in libraries. Books containing RFID tags can be identified by passing a scanner along a shelf, thus eliminating the need to handle each item. Self-checkout systems based on RFID technology enable individuals to borrow and return multiple books quickly and easily. Such systems have been in use in Singapore for nearly a decade. They are now being implemented or considered by large universities, including Oxford, to facilitate the mass shifting of books to and from remote locations. They may be used to manage books moved to temporary scanning locations for the Google digitization project. Again, this may seem an innocuous application when viewed only as an inventory control mechanism. However, libraries are concerned about how to maintain privacy when individuals are carrying library books that contain live tags. In theory, a student bookbag could broadcast the presence of the Bible, the Koran, Nazi literature, or a pamphlet on how to make bombs. Libraries traditionally have been concerned with privacy and the freedom to read anonymously. Most librarians would prefer that a book broadcast a random number that is meaningful only to a local system, but industry standards might force the adoption of RFID tags tied to ISBN or another universally meaningful number.

Education and Data Management

My own research on embedded network sensing is in the areas of education and data management. Sensors are among the technologies contributing to the 'data deluge' (Hey and Trefethen, 2003) that is one of the main drivers of e-Science. The amount of data produced far exceeds the capabilities of manual techniques for data management, and thus the need for control of these data is another essential driver of e-Science (Lord and Macdonald, 2003). Once these data are captured and curated, they can be shared over the distributed networks of e-Science. If these same data can be made available for other applications such as e-Learning, many opportunities arise for economic and political leverage of the investments in e-Science.

Scientists who share data tend to have similar disciplinary knowledge and analytical skills; such similarities cannot be assumed when scientific data are shared with teachers and students (Enyedy, 2003). Making scientific data useful for educational applications while at the same time maintaining the system's value for scientific research is a complex problem that has received little research attention. To serve these two communities with one set of resources, two potential conflicts must be addressed. One is that scientists and students collect and analyze data for different purposes. Scientists' primary goal is the production of knowledge for their community, while students' primary goal is to learn the concepts and tools of science. For students, 'doing science' is a means to learn new content and skills. In the ideal case, students also will generate data that contribute to knowledge in their classroom and school community and to scientific knowledge.

The second conflict is that scientists, teachers, and students bring far different skill sets and epistemologies of science to the use of scientific data. As part of their graduate study and research training, scientists have learned practices to select, collect, organize, analyze, store, and disseminate data; these practices often are specific to their discipline or research specialty within a discipline. These practices reflect a tacit understanding about what the nature of science is, what researchable questions are, what knowledge claims look like, and what sorts of evidence are expected to support such claims. By comparison, teachers and students at the middle and high school levels generally lack deep subject knowledge, research methods expertise, and knowledge of data management practices. Students in introductory university courses may have only slightly more knowledge of scientific practices than do high school students. The knowledge and skills gaps between these communities must somehow be bridged if e-Science data resources are to be useful for e-Learning (Borgman, in press; Borgman et al., 2004).

CENS' sensor networks currently are deployed to study habitat biology, seismology, contaminant transport, marine microorganisms, and several other topics. Habitat biology is the central focus of our data management and education research; we also have begun working with the seismology research team. The habitat data are being generated by sensors at an ecological reserve in the mountains east of Los Angeles (James San Jacinto Mountains Reserve, 2004) and captured in databases. These data can be monitored in real time or analyzed as datasets over selected time periods. Scientists, teachers, and students (grades 7 through 12) will have access to these data in real time and access to archives of previously generated data.

We are pursuing research questions about how scientists, teachers, and students determine their data requirements, their criteria for selecting and preserving data, their use of scientific data and how that use evolves over time, and incentives and disincentives to contribute data to repositories. The methods applied to date are formative, and include attending workgroup meetings of scientific teams and analyzing their work products (datasets, websites, publications), interviewing individual faculty and research groups, visiting research sites, and identifying available data repositories, metadata standards, and structures (Borgman, 2004; Sandoval and Borgman, 2004–08; Shankar, 2003).

Converging Research Problems and Technologies

CENS provides a rich set of examples of scientists, engineers, and social scientists working together to build, deploy, and study emerging technologies. We have a very friendly and effective collaborative environment, consisting of boundary-crossing scholars who are genuinely interested in learning about each others' domains. I have gradually come to understand not only the goals of individual teams, but the tight coupling between them.

Seismology offers the clearest examples of convergence and dependence. Seismic sensors must be calibrated in time and physical location to near atomic accuracy. Seismologists study the force and movement of earthquakes, and observe the flow of signals not only through their own instruments, but through instruments placed around the world. Thus they depend greatly on the accuracy of their colleagues' instruments and on the ability to aggregate data in standard forms. Seismology and structural engineering have been surprisingly separate fields, but they are working together in CENS. Their experiments merge instruments that originate in different research traditions. We have the most instrumented building in the northern hemisphere, enabling our teams to follow the movement of earthquakes up, down, and around a 14-storey building. It is remarkable to me that this form of study is so new.

All of the sensor network technologists and scientists are dependent upon the electrical engineers who study calibration. They are applying research from military applications (e.g., weapons placement) to improve the reliability of data not only for seismology and seismic engineering, but for the biologists to pinpoint the location of birds while performing certain songs. This technology, if successful, will enable biologists to determine the relationship of location (e.g., in a tree, in an open field) to bird songs for the first time.

The networked sensing technology also is dependent on communications technology such as global positioning and wireless networks. GPS is effective only in open spaces where three satellites can be seen concurrently. Thus it is not useful inside buildings, under ground, or in canyons, severely limiting its use for seismic applications. They can compensate for this limitation if they can triangulate location accurately between hidden sensors and those within range of GPS. For this problem, they are experimenting with long distance, line-of-site wireless technologies. Experiments linking wireless sensors across the width of the San Fernando Valley in the summer of 2004 were promising. They need these technologies for a large deployment in the mountains of Mexico where some of the world's most devastating earthquakes have occurred. If they can improve earthquake safety in Mexico City and Acapulco, thousands of lives might be saved—that is, if they can make all of these technologies and associated data converge.

Post script, from the Social, Legal & Ethical section of the CENS site (http://www.cens.ucla.edu)

Pervasive tagging of physical objects raises privacy concerns and also issues of change in the workplace. However, there are far broader implications from the nexus of sensing and pervasive computing technologies from new social interactions to citizen control of monitoring activities previously the province of government through to large changes in the economy. While prediction of social outcomes of new technology is difficult, nevertheless we believe it is the responsibility of technology developers to engage with the broader community so that appropriate societal values can be built into the regulations and the information technology itself at an early enough stage to be cost-effective.

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On the Origin of the Web Species and Complexity

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Abstract

This paper discusses the web as a complex system and proposes four programmes of research on the structure and evolution of the web. After discussing the concepts of complexity and complex systems it formalises the problems of web structure and evolution under the framework of complex systems. It examines the mechanisms and organising principles underlying web structure and evolution, particularly self-similarity and self-organisation, structure, emergence and dynamics. A provocative account is provided on 'preserving' complexity on the web and its future evolution based upon its original mechanism of hyperlinking.

Keywords: complexity, web structure, web evolution, complex networks, socio-technical systems, internet

Introduction

Complexity is a difficult concept. The root of the Latin word *complex* means 'twisted or joined together' [from cum (together) + plecto (I put)]. The concept originating from the Greek word "…", meaning the quality of being complex. From online sources (e.g. http://www.etymonline.com/index.php?term=complex) we obtain the etymology of the concept. Complex (in http://dictionary.reference.com/search?q=complex) means, 'composed of parts', from Fr. *complexe*, from L. *complexus* 'surrounding, encompassing,' pp. of *complecti* 'to encircle, embrace,' from com- (with) + plectere (to weave, braid, twine). The adj. meaning 'not easily analyzed' is first recorded in 1715. Common synonyms of complexity are entanglement, intricacy, elaboration, multiplicity and ramification. A usual antonym to complexity is 'simplicity'.

From the Columbia Electronic Encyclopaedia, Sixth Edition, Columbia University Press, available at www.cc.columbia.edu/cu/cup/we one obtains the following definition of complexity as a field of study.

> Complexity, in science, is a field of study devoted to the process of self-organization. The basic concept of complexity is that all things tend to organize themselves into patterns, e.g., ant colonies, immune systems, and human cultures; further, they go through cycles of growth, mass extinction, regeneration, and evolution. Complexity looks for the mathematical equations that describe the middle ground between equilibrium (see statics) and chaos (see chaos theory), such as the interplay between supply and demand in an economy or the relationship among living organisms in an ecosystem.

Complexity theory had its beginnings with American mathematician Norbert Wiener's development of cybernetics, Canadian biologist Ludwig von Bertalanffy's development of general system theory, and American mathematician John H. Holland's development of a computerised artificial life simulation. More recent efforts are centred at the Santa Fe Institute

in New Mexico, which was established in 1984, and are found in the work of multidisciplinary researchers such as American economist Kenneth Arrow and American physicist Murray Gell-Mann. Because complex systems typically cross the boundaries of traditional disciplines, the study of complexity is an interdisciplinary science. Much of the progress in the field can be attributed to advances in nonlinear dynamics, in the power of computers and in computer graphics, and in adaptive programs and fuzzy logic.

Complexity has different meanings in different contexts. Potentially, a rich interplay among the various 'languages' and contexts might prove to be the most fruitful approach.

Complexity appears in the study of complex phenomena in natural systems. Basic themes include the dynamics, interactions, emergence, adaptation, learning, and evolution of a system. dddmag.com/scripts/glossary.asp

From a computer science perspective, complexity is examined in three complementary forms: time complexity, computational complexity and space complexity. Time complexity refers to the estimated time taken to complete a particular task. This is particularly related to *scalability*, and how much time a certain algorithm takes to compute or process a certain input n and how this scales as n increases. In this regard algorithms can preferably be O(1) if the computational time required is independent of the systems size, be O(n) if they scale linearly with the size of the problem n, O(n^2), O(n^3) and so on. Computational complexity refers to the total number of steps required to complete a certain task. Space complexity refers to the total amount of memory required to complete a certain task.

From a physicist's perspective, complexity is taken as a measure of the disorganisation of a certain system. Entropy is a measure that accounts for the amount of disorder in a particular system.

From a biological perspective, complexity accounts for the intricate nature of organic systems, in which the unexpectable interplay of basic components can generate the intricate complexity observed in organisms.

From an engineering systems perspective, the complexity of a certain system or one of its components is related to the time taken to design and implement such a system or respective components. A set of structure-based metrics measures the attribute of the degree to which a system or component has a design or implementation that is difficult to understand and verify. IEEE96 (www.hi.is/~oddur/spisland/ref/def.htm). The degree to which a system's design or code is difficult to understand because of numerous components or relationships among components (www.construx.com/survivalguide/glossary.htm).

From a social science perspective, complexity is commonly related to the interaction of several elements or components into an integrated whole and more concretely to the incapacity to deal with this intricate and inexplicable social complex system. The interaction of many parts, giving rise to difficulties in linear or reductionism analysis due to the nonlinearity of circular causation and feedback effects. The degree to which the structure and behaviour of an organisation, application, or component is difficult to understand and verify due to its large size, the large number of relationships between its components, and the large amount of interactions required by its collaborating components to provide its capabilities (www.donald-firesmith.com/Glossary/GlossaryC.html).

Towards a more integrative framework on complexity, this means the degree to which simple micro-scale properties and behaviours can generate intricate and 'complex' macro-scale phenomena, observed and experimented in those of the above contexts, from physics ad mathematics, to biology and the social sciences.

Modelling the Web as a Complex System

We can model the web as a graph (Kumar et al., 2000), indeed a large-scale and sparse graph. A graph is a mathematical representation of a set of nodes (entities) and edges or arcs (links) among those nodes. Additional information (such as intensities or strengths of association) can be attributed to either nodes, arcs or both. More information can also be determined for subcomponents of the web graph or for the whole graph, such as its size, connectivity, density, clusterability, and so on.

A number of interesting properties have been the subject of thorough analysis with regard to the mathematical and statistical characteristics of the web graph. These properties include the degree of *distribution* of nodes in the graph, the *average path distance* among nodes in the graph, and the *clustering coefficient* of each node and the graph as a whole.

Nodes in the web graph possess different and significantly skewed *out-degrees* and *in-degrees* (respectively, number of links *originating in* a certain node, and number of hyperlinks *directed to* a certain node). Power law distributions or some variations of 'power laws' have been discovered to characterise the web graph and subcomponents of it (Kleinberg, 1999).

Despite its large-scale nature (Google indexed 8,058,044,651 web pages on the 3rd of April 2005, and probably this accounts only for 15–20% of the open and public or 'surface web'), the average distance among any two connected nodes in the web graph is relatively short (19 links maximum) when compared to a similar size random graph (Réka et al., 1999).

Given the size of the web graph, its power law or scale-free nature as well as the short average path distance between any two nodes, the clustering coefficient of nodes (a measure of the total number of existing links as compared to the total possible links in a certain vicinity) is surprisingly high. This *cliquishness* of the web graph and its subcomponents brought attention to several possibilities regarding the self-organisation and emergent properties of the web.

More recently, models of the structure of the web graph (Kleinberg and Lawrence, 2001), ranging from the complete random model graph (derived from initial work of Erdos and Renyi, 1959) to more detailed representations of the Albert & Barabasi model (2002), have been suggested. A detailed representation of the hierarchical nature of the organisation of the web is provided in Ravasz et al. (2003).

As the web graph is a dynamic system always evolving and re-shaping its structure, recent research has been focused on the properties of the evolution of networks and the evolution of the web graph (for a review see e.g. Dorogovtsev and Mendes, 2003).

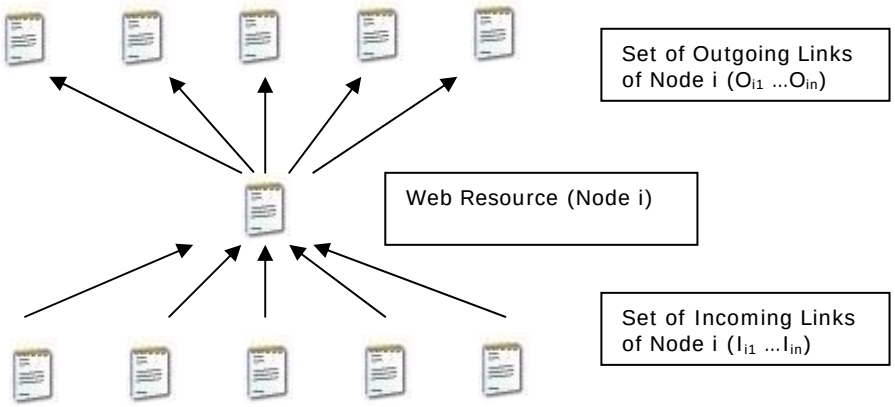

Figure 1. Original mechanism on the web: hyperlinking

If we model the evolving web as a dynamic system, and accept that the basic mechanism explaining its behaviour is the hyperlinking of web resources, then four basic processes characterise the evolution of the web graph:

- addition of new nodes
- addition of new links
- removal of existing nodes
- removal of existing links

Naturally, a combination of these four basic processes can produce a more complex dynamic behaviour over the time evolution of web graphs.

A better understanding has been gained on how the micro-level processes of hyperlinking can produce the macro-level structure of the whole web (Reka and Barabasi, 2002). However, much more empirical research is needed in order to understand how typical characteristics of complex phenomena such as self-organisation (Kumar et al., 1999), emergence, and self-similarity patterns merge from the interplay of micro-level processes and macro-level structure (in the same vein as Wolfram, 2002).

We will be particularly interested in models that combine the statistical characteristics underlined above with the socio-technical nature of the complex systems of collaboration and interaction emerging in these large-scale networks.

Four Programmes of Research on Web Structure and Evolution

There are three particular characteristics of this socio-technical complex system we will be interested in gaining a better understanding of.

First, the web possesses a complex 'structure'. The 'web', as a socio-technical network, with nodes, arcs and intensities among its elements, possesses a complex structure, neither of a random nature, on the one hand, or of a completely regular and perfect form, on the other. Some kind of structure (meaning by structure a stable pattern of relationships emerging from continuous inter-relationship) lying on a spectrum between the complete random model and the complete regular model, should characterise Internet networks. We will be interested in determining the properties of this web structure.

Secondly, the web is a dynamic and constantly evolving system. Nothing on the web, including its structure, remains the same at two different moments. The web is constantly evolving (growing at a rate not yet determined) but particularly reshaping itself over time, which means the web is different from time t to time t+1. This fact, of common sense and empirically confirmed, brings important problems for 'preserving the web' over time. How can one be certain to find or recover the web of time t–5, or t–10, as we still lack a 'memory' of the web? We still don't fully understand how the web evolves over time, and that understanding might help one gain better control over the problem of 'preserving the web'. We will be interested in determining the essential properties of the evolution of the web.

Finally, but most importantly, we understand the web as the largest and most complex information system ever built by humanity. The web represents the most complex repository of data, information and knowledge, available for public and worldwide access and use. The pervasive nature of the web, the processes of distributing and autonomously transacting data on the web have created an apparently gigantic and non-organised volume of information on the Internet. Nevertheless, the structure and evolution of the web apparently possess some self-organisation characteristics and we are able to 'discover' more compact and densely connected zones of 'information' and 'knowledge' in these large and sparse Internet networks. We have designated these as 'Internet Knowledge Bases' and we will be interested in studying their characteristics and properties.

The World Wide Web (the web) is a large-scale and distributed electronic network sharing information and resources worldwide. The dynamic nature of this system, as the web grows exponentially and its structure changes permanently, represents a significant challenge for the digital preservation of electronic resources. Nevertheless, 'preserving the web' is essential for the long-term access and use of information and knowledge bases currently being shared on the web. The development of a public and worldwide distributed computing project to analyse the structure and evolution of the web is also part of this proposal.

The structural inter-linkages (arcs) among webpages (nodes) and other electronic resources, and the methods that study these graph properties of the web (web metric methods), can contribute to maximise digital preservation in such a complex environment. Webmetric methods, particularly those focused on analysing the structural linkages of the web graph, provide a way to identify, store and 'preserve' stable (in the long term) and regular patterns or subsets of the web graph, hence contributing to preservation of web resources.

Some specific characteristics concerning (i) *scalability of the web graph*, (ii) the *multi-language nature of web resources*, (iii) *diversity in topics of web resources*, as well as (iv) *different geographies on the Internet* will be of particular focus for analysis in this project.

We will be particularly interested in testing these webmetric methods in large scale portions of the web graph, and analysing how 'scalability' influences their 'preserving' capabilities.

The web is an enormous repository of information represented in multiple and diverse languages, worldwide. Despite the current disproportion of availability of English information on the web (which is explained by historical and geographical reasons) language diversity is an intrinsic and natural endowment of the web. Preserving digital information in multiple languages dramatically influences our previously stated 'preservation' problem.

The web is a heterogeneous system, varying greatly by geography but also by the 'topicality' or nature of the information being distributed and accessed within this network of networks. There is now extensive empirical confirmation that topics on the web are not evenly represented, i.e. some topics attract more interest than others, and some topics are more represented and publicly available on the web than other less represented areas of interest. Thus, 'topicality' is likely to have an influence in our 'preservation' problem.

Finally, the web represents a multitude of different geographies, where 'proximity in space' exerts an influence, despite its worldwide nature and scope. Differences in web space organisation and structure are likely to exist according to different countries and geographies. This is also likely to influence the capability of webmetric methods to 'preserve' digital resources in the medium-to-long term.

The project uses ecology of software agents in a distributed computing platform to collect and analyse webmetric information in 10 different countries, over a period of 18 months. webmetric data is focused on academic webs. This is explained given that academic information is more fully and openly available on the web, digital resources are better represented on the web due to the research-based historical nature of the Internet, as well as the fact that access to academic resources is more effectively granted.

Given the extremely dynamic nature of the web, as well as the complexity of its structure and large-scale properties, this project also launches a worldwide project to understand the structure and evolution of the Internet, based upon public and worldwide distributed computing platforms, similar to the SETIE@home, FOLDER@home and similar projects.

The setting-up and development of this public worldwide platform (WEBStructure@home), based at the Oxford Internet Institute is also a fundamental objective of this project. This distributed platform will allow any worldwide computer to participate in the collection and analysis of this project, by accepting to use the computing power of their desktop systems while not in use (i.e. *screensaver* mode) for collecting and sending processed web data to the home project system at Oxford.

The WEBStructure@home project will benefit from its distributed architecture, as well as other characteristics such as being multiplatform (clients can run on Windows, Macintosh and Linux systems), supported in data standards (XML-based representation of web data collections), language-independent and recourse to agent-based software systems, that enhance its distributed architecture by providing concurrent processing and autonomous computing services.

By adopting the most advanced techniques for collecting web linkage data, based on a distributed computing system, one will be allowed to collect and analyse dynamically such large volumes of data from the web. This will provide the needed computing performance, as well as processing time required to dynamically analyse the web's structure and evolution.

Conclusions and Further Research

The structure and evolution of the web can be modelled and analysed as a complex system. The most fruitful approaches in order to gain a better understanding of this complex system might derive from the rich interplay of several disciplinary backgrounds from physics, mathematics and biology to economics and sociology. A new science of complex networks is emerging in this endowed 'trading zone' of interdisciplinary theory, methods and applications.

It seems that micro-level mechanisms of hyperlinking can to a large degree explain part of the observable complexity at the large scale and macro-level structure. Nevertheless, much more research, particularly bridging interdisciplinary fields of study, is needed in order to gain knowledge of the essential processes explaining the dynamic behaviour of the web.

Gaining a better understanding of the fundamental mechanisms originating the complex and dynamic behaviour of the web graph is crucial for policy and social reasons. Understanding the web as a complex dystem might throw some light on its fundamental origin, evolving nature and simplicity.

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The social implications of online text

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The following research areas all relate to a central question concerning the relation between online text—for collaborations, for reading and for learning—and the people who use it.

(1) Discourse

The creation of the networked society has probably been one of the most profound impacts of the WWW. An enormous amount of this network is still in the form of online text-based communication (emails, discussions, fora, chats, collaborative spaces, blogs, MUDS, etc.). Texts do not have meaning in and of themselves, but only in the context of the social interactions around them. This is reflected in, for example, the interpretive assumptions of participants in discussions, which are generally geared not towards the text as such, but towards the intentions of participants. However, it's difficult to say whether a contribution to an online discussion has its meaning determined by the intention of its sender or whether its meaning is a much more collaborative affair in the context of the discussion, and so a matter of collective intention. The relation between interpretation and intention in turn has an impact on a variety of other issues, most importantly presence (for example, what is the relation between presence and intention in online discussion?), identity (for example, how much and what can be faked in an online discussion?), and related ethical issues (for example, what are the semantic transactions that require trust, to what extent can trust be safeguarded, and what safeguards are either being transferred from other contexts, or are evolving?).

(2) Hypertext

It has been claimed that hypertext will revolutionise reading and learning in view of the profoundly different relations to text that the web has instituted, where readers take on responsibility for the creation of meaning. While the original claims made by George Landow and others were probably hyperbolic, hypertext is certainly likely to put pressure on reading practices in a wide range of domains, from entertainment to scholarly publishing. However, it is difficult to evaluate the extent of this pressure, what changes are emerging or are likely to emerge. The questions that emerge have to do with the meaning and interpretation of these texts: for example, does 'surfing' hypertexts put meaning in the hands of users, and if so, with what implications? How is authority exercised in hypertext, and by whom? How is power deployed, and how can it be resisted? Historical research on the evolution of the book, empirical and psychological studies on reading, and philosophical and conceptual studies on meaning, interpretation and related matters can all make an input.

(3) Experience of personal identity

The WWW puts the means and mode of discursive representation in the hands of ordinary individuals to an unprecedented extent. The discourse of online communication and hypertext are two ways in which those who have traditionally been regarded as listeners, addressees, and recipients of discourse now have the means at their disposal to intervene in discourse, to engage with it and make it their own. There is a very close connection between discourse and the formation or construction of identity in all its aspects from the physical to the social. How

do the permutations of the online world affect the possibilities of identity formation and construction? On the one hand, we see an apparent greater ease of 'faking it', with all the concomitant problems of authenticity and trust; and on the other we see an apparent greater liberation and freedom from the contingencies of personal luck (or lack thereof) in the attributes we simply have, are born with or into. What research methodologies are required so that we can begin to understand the way in which people experience their own identity(ies) in the online world?

(4) E-learning

E-learning is just beginning to take hold in educational institutions, and research into e-learning is as yet immature. The domain of e-learning has tended to bring together people from very different disciplines and backgrounds; in addition, as an area of study it invites a multi-disciplinary approach. However, multi-disciplinarity can create as many frustrations as it does opportunities, as there is sometimes such a wide divergence between researchers that each is left in relative isolation, talking only to themselves or to a small enclave of like-minded people. There is a need to find ways of making explicit what are the research methodological issues that divide e-learning researchers, so that they can begin at least to agree about where their disagreements lie. There is also a need to try to articulate the ways in which different research methodologies can complement each other.

As much as there is a need to address these issues in e-learning, there are deeper questions concerning the phenomenon of multidisciplinarity itself, which is becoming increasingly prevalent: how is this influenced by online technologies, and thus, how are these technologies changing the nature of scholarship and research?

The Socioeconomic Impact of New Technologies

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Complementarity and interoperability

Many aspects of new technology uptake and its effects are analysed in terms of static aggregates, with a sharp distinction between individual and group goods and services, property rights and impacts. This does not mean that dynamics, social networks and the problems inherent in treating knowledge, trust, identity and similar intangibles as purely private or public goods are ignored, but rather that the analysis tends to refer to equilibrium situations, to consider issues such as inclusion and identity in terms of group membership and that to treat property rights as exogenous consequences of combined legal and technical forces. For instance, technologies that depend for their value on interoperability or 'positive network externalities' (the more others use a given technology, the better it is for me to use it) have certain well-defined effects:

- A tendency to domination by a single technology or application (the so-called 'tipping equilibrium') and the formation of fairly clear 'in' and 'out' groups around it;
- A possibility for 'excess volatility' as technology exploiters race to create a proprietary *de facto* standard—trying to build an installed base and to lock in suppliers of complimentary goods and services;
- A countervailing possibility for 'excess inertia' as individuals hold off adopting a technology until a 'critical mass' of their peers have done likewise;
- A tendency for small initial advantages to deepen and harden over time;
- A resulting possibility that the adopted standard will *not* be the most efficient of those on offer; and
- A form of incumbent advantage that can lead to long-term dominance.

These natural consequences of the 'shared-value' aspect of many new technologies mean that their future course and effects are not necessarily well-predicted by models based on efficient markets or technological competition. In particular, the possibilities of irreversible change and the 'unbundling' of commercial and societal objectives must be taken seriously.

Property rights

Property rights are a traditional means of facilitating efficient use of resources and providing equitable returns which motivate further innovation. There are well-known difficulties and unintended consequences of their too-ready extension to virtual spaces created by new (ICT) technologies. As a result, it may be useful to revisit the underlying assumptions.

Ideas, before they are codified or otherwise expressed, are more like private than public goods. Indeed, they are even more private, since they will not outlive their creators unless

expressed. If communicated, a copy (another private good) is created through the use of private inputs like time and attention. Thus, it is not obvious that they need any particular protection. Certainly, there seems little justification for protections that go so far beyond those accorded other types of property—like the notion that the purchaser should have to obtain the seller's approval of how the property should be used. This is particularly true for innovation, since most useful technological innovation arises through use rather than formal scientific R&D (see forthcoming Reith lectures at: http://www.bbc.co.uk/radio4/reith2005/lectures.shtml#lecture2).

In the virtual world, even more than in the physical one, names are valuable. In particular, domain names are intellectual property (intangible intellectual products that can be owned and transferred) independently of how the property rights are enshrined in law. It is vital to consider how they should be defined and protected—and what the likely impact of treating them in different ways might be. Matching these things to existing bits of law is a pointless exercise. Unless we are prepared to ask why these things should be protected we are unlikely to devise protection that is worthwhile.

Scientific information is another area where IPR have been vigorously pursued. Even if some form of special protection is desirable, it is not clear that current regimes provide that protection. Copyright arrangements, for example, seem to favour the interests of particular distribution channels over those of authors or readers (Parliamentary Science and Technology Committee Report at: http://www.publications.parliament.uk/pa/cm200304/cmselect/cmsctech/399/39902.htm). Moreover, the benefits of electronic distribution accrue in the first instance to the author and only eventually—and collectively—to the readers. This suggests that a combination of author-pays and open-access (or at least open archiving of peer-reviewed literature) should supplant the current model.

Identity

A further form of 'intellectual property' is personal identity. New technologies—e.g. biometrics—create the possibility of 'strong identity'. This raises a number of difficult issues:

> Identity in terms of a physical body may be less relevant in a world of virtual agents, or a world in which the physical individual is a focal point for an economic entity rather than a decision maker (e.g. carers making transactions on behalf of their charges).
>
> Biometric identity may be 'too strong' for many purposes, such as cash transactions, voting, etc.
>
> The perceived strength of biometric identity may 'crowd out' other channels, leading to a loss of resilience and even the erosion of trust. For instance, a reliance on biometrics for physical access (e.g. border) control may lead to a lack of skilled personnel who can exercise judgement. In this case, the effectiveness of the system is entirely dependent on the quality of original enrolment data and whether people are admitted if they are on a database of authorised persons or denied entry if they are on a list of 'personae non grata'.
>
> Biometric identification, like any other form, may suffer from three types of error: false positives, false negatives and precise solutions to the 'wrong' problem. It is not obvious that these will be appropriately balanced in applications.
>
> Some applications raise particular issues: for instance, fingerprints, etc. cannot be re-issued if compromised—but iris identification can (be making a different random sample of the original template). Not all forms are suitable for use with all populations. The costs may disadvantage certain groups of potential users or even harm small businesses in competition with large chains.

Because biometric identity is regarded as strong, it is difficult to repudiate. This raises two concerns. The first is that errors become at the same time less likely and far more serious. The second is that identity theft may give way to 'denial of identity service' attacks as a channel for fraud and abuse.

Network structure and dynamics

A final point is that analysis may need to take account of evolutionary and other dynamics of networks.

New technologies derive their impact from interactions among networked entities; the unfolding effects of technology use influence the structure of networks and behaviour within them; and network considerations in turn shape the uptake and use, if not the very emergence, of new technologies.

The networks in question are not only physical, but include a layered series of connections mirroring the structure of knowledge:

The semantic web of meaning (simply, ideas, technologies, etc. and logical or practical connections among them).

The personal web of those who create, apply, and utilise knowledge (individual scientists, businessmen, policy-makers, customers, citizens, etc.)

The organisational network of institutions to which the individuals belong and through which they act.

These correspond (imperfectly) to codified, tacit and systemic knowledge, so it is legitimate to think of each 'layer' as a domain in which knowledge evolves. Evolution is the result of:

- Variation (or mutation): 'formal' (R&D) and informal (experience) innovation
- Selection: scholarship (separating 'good' knowledge from 'bad'), market testing and policy experience
- Heredity: teaching, copying, cumulative development and scientific publication

In addition to evolution within each layer, there are important spillovers: a powerful 'meme' (package of ideas) not only reorganises related concepts but also attracts scholars and institutions. A particularly creative or inspiring individual attracts others (who will work to elaborate and test the individual's insights, reshaping the semantic web) and institutional participation and support. Finally, as with the OII itself, focused institutions can attract individuals or give particularly forceful expression to ideas, triggering emergence of new 'memes' or even schools of thought.

The internal structures of networks influence their performance. Physicists have developed a rich body of results on the basis of simple (even simplistic) models of network dynamics. This work highlights such structural features as the path length between network participants, clustering (the probability that two nodes sharing a common link are themselves linked) and the distribution of linkages. These can be casually linked to socioeconomic effects: 'close' individuals can exchange ideas, and trade, conspire or otherwise coordinate activity. Clustered individuals may be able to debate ideas or create efficient informal institutions to mediate their exchange (such as trust or reputation). Highly asymmetric distributions of 'power' or importance may concentrate responsibility or lead to inequality and exclusion. The literature works on two basic models: the 'scale-free' model characteristic of random networks (low clustering and highly asymmetric distributions); and the 'small world' model (short path lengths and high clustering). It is not obvious which geometry is 'best' for social effects:

cohesion is high in a small worlds network; but the percolation of new ideas (for better or worse) may be slow. It is also not obvious whether one or another type of network is 'more likely' or how new technologies or policy will affect the shape of networks. What is fairly clear is that different types of network (e.g. publications, patents, business alliances, e-commerce, blog discourse, etc.) have very different geometries.

The game theoretic approach starts from an interaction among participants (typically a coordination situation) and examines the twin effects of cohesion and contagion. Different geometries offer different possibilities for efficient coordination and/or diversity. Models in which structure as well as behaviour are the result of choice show some tension between stable and efficient outcomes. In particular, such models shed light on the possible evolution of conventions and standards and refine the 'group-based' analysis in point 1 above, showing that details of societal structure matter for the conclusions and are themselves likely to change as technologies spread.

Division and opting-out

One particular point concerns the so-called digital divide. Much has been made of asymmetries of access and participation: but they are not the same and should not be conflated. In a static sense, it is necessary to provide a diversity of channels. Group-working can encourage group-think or free-riding, and some degree of opting out is probably desirable. Indeed, a number of social institutions (including academe) deliberately inhibit 'inclusion' for some period and some purposes. This is a long subject: the purpose here is simply to pose the questions: is universal inclusion preferable to the absence of exclusion, and in what way should individual and collective preferences regarding inclusion be taken into account? Beyond the obvious application to things like the Internet, this should be applied to a whole range of new technologies: when there are important externalities, when socioeconomic effects are potentially sudden and irreversible and when the boundaries between 'knowledge' and 'preference' are fuzzy, how can we mediate the development and uptake of technologies in order to restrain an endless and hasty quest for mere novelty?

Multi-disciplinary engineering

David D. Clark

The Internet is a built artifact—the technology is not exogenous. One can build models to explain why and how it changes, and in the context of today, technical innovation is not the prime driver in these models. We must look, instead, to economic forces, social issues, regulatory and legal rulings, global diversity and similar factors to understand the future.

The technical community is to some extent wandering lost in this larger picture, in need of guidance. More and more, the question they must face is not 'how can I build some cool technical thing?' but 'which thing should I build so the results are relevant and useful?'

In fact, the actual process of evolution is rich with incoherent innovation, constantly redirected by the tussle of competing interests, and in no sense moving toward a long-term vision of where we should be. We evolve away from where we are in all directions at once, but not toward anything. And in this process, there is no clear cycle of design—no design phase followed by a build phase followed by a use phase. They are all jumbled up. If the Internet were a car, advocates would be adding and removing parts as you drove down the road.

At the highest level, this story raises interesting questions about different conceptions of technology: Bruno Latour might say that 'Technology is Society made Durable', but the plasticity of software, combined with the constant entrance of new actors onto the scene, makes the Internet seem more a dynamic process in a state of flux rather than a manifestation of durability and resistance to change. One might speculate, with the tools from different disciplines, how this balance between change and immutable maturity might play out in the Internet.

But at a lower of level of detail, the process of specification and design begs for input from other disciplines and other methods for assessment and analysis. This input should come as part of the design, not as an analysis after the fact. Technologists (like me) need to reach out and find colleagues from other disciplines who want to join the process of evolving the artifacts like the Internet.

To make problem space concrete, here are some specific examples of places where change is happening right now, where visions of the future are being turned into technology, and where input from many disciplines might help us 'get it more right' sooner in the process.

(1) The nature of Internet identity. The users on the Internet sit in a rich space of identifiers, which reveal various aspects of their identity. This space is evolving over time, generally in the direction of revealing more about identity. This trend is driven both by commercial concerns and by the need for policing and accountability. Do we have comment or advice about these trends, and about the mechanisms that might be built and deployed? Could clever design give us a new conception of identity and privacy?

(2) A universal location infrastructure. We might set an objective that we design and deploy an infrastructure which builds on GPS to allow a device (or person) to know 'where it is' under all circumstances—inside buildings, tunnels, etc., as well as out in the open. This goal would have profound implications, both positive and negative. Can we understand these implications and offer guidance to the design and use of such a system?

(3) The personalized experience. Today Google offers us advertisements tailored to what we are looking at. Amazon offers us recommendations based on our past behavior with them. We can easily imagine a future where our experience is totally tailored based on who we are, what we are doing, and where we are. What are the implications of this world? And this topic

can also include a consideration of gated communities, and the tendency of people to seek out and converse with like-minded friends. Will the personalized experience lead to intellectual in-breeding and extremism?

(4) Leaving no user behind. The question is how we deal with two issues: cyber-literacy and users with impairments. In the real world, the government deals with both of these. The issue of impaired abilities is addressed in the US through the Americans with Disabilities Act, which imposes obligations on the private sector. On the Internet, there has been no such intervention—it is viewed as a private matter how usable a web site is, how much skill and training (and computer performance) is required to use it, and so on. Will we see government intervention here, and if so, in what form?

(5) Global variation in the Internet experience. We see different national approaches, such as Internet regulation in China. There are issues that arise from implementation of lawful intercept (wiretap), which (once it is implemented as a technical capability) will be implemented according to the law differently in each sovereign jurisdiction. How should we reason about the design of mechanism in this context?

(6) Loss of confidence—can I believe my eyes? The phenomenon of phishing, where an email pretends to be from someone else, erodes the basic sense of confidence that users have in the Internet. In fact, phishing is just the tip of the iceberg. As users more and more search for information using tools like Google, what basis do they have to believe that anything they find is what it seems? A search can take you anywhere, and there is no way to verify the authenticity of anything you see. What tools, and what redesign of user interfaces, should be put forward to mitigate this problem.

(7) Rules for surveillance in cyber-space. We are beginning to evolve social rules for the operation of surveillance cameras—whether the space has to be posted to warn people of their presence, whether they are big and bright-colored or tiny and hidden, and so on. What are the conventions for surveillance in cyber-space. Do users have the right to know if their behavior is being observed or logged? Under what circumstances? And so on.

This list could go on and on. The Internet is rich with examples, and the broader space of pervasive or ubiquitous computing is even broader. How should we think about RFID tags? Are there issues in pervasive private-sector monitoring of the environment, or health issues, weather, or even traffic? Privacy is the obvious issue that comes up first, but it is by no means the only, or even the most important issue.

My interest, as a technologist that thinks about the ‘architecture’ of systems—the high-level set of design decisions that frame the overall structure, is to find ways to engage people from other disciplines and make them an active part of the design process. Some fields have engaged this mode of behavior. For example, economists are involved in mechanism design ranging from spectrum markets to the real-time Vickery auction that drives ad placement on Google. But we need a broad spectrum of inputs to shape this world. And we need to devise modes of collaboration that work.

Here is a specific challenge. The US National Science Foundation is considering the following question: is it time to engage the network research community in a coherent and unified project to redesign the architecture of the Internet. If they do put this program in place, how can we make sure that the process is not just driven and shaped by technologists?

Merging Technologies and E-Democracy

Stephen Coleman

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Attempts to democratise mass political communication are beset by problems of scale. The internet makes many-to-many communication *technically* possible, but the organisational, cultural and political consequences of hundreds of thousands—or millions—of citizens contributing to national and global policy debates are more than most polities can handle. It is as if we have invented the telephone mouthpiece, but not the earpiece. The potential of the internet as a tool for mass expression must be matched by the capacity of message-receivers to make sense of such vast inputs. This calls for the development of technologies and techniques of data filtration, aggregation and visualisation.

In the context of mass democracies, the efficient regulation of information flows calls for processes of automated filtration. For example, elected representatives faced with a rapid flow of diverse messages are likely to feel overwhelmed unless they have access to technologies that can

(i) identify message sources

(ii) sort and classify different types of messages

(iii) identify common themes and semantic patterns within messages

The same applies to information flows in the other direction: citizens need to be able to cope with a superabundance of political messages and to be in a position to review and scrutinise the sources of public information.

Filtration involves the management of information flows; aggregation entails the construction of meaningful relationships between obstensibly discrete information data. For example, filtration technologies might help one to avoid having to read every blog in the world in order to derive some information from bloggers, but other techniques are required in order to encounter something as broad as the mood of the blogosphere. Tools such as RSS and Blogdex provide approaches towards such aggregated accounts of social information.

Much attention has been given to the scope of visualisation as a means of simplifying and making accessible complex volumes of information. Using methods ranging from artificial intelligence to discourse architecture, information scientists have attempted to identify and represent the shape and structure of mass communicative interactions in qualitative terms (Donath et al., 1999; Macintosh and Renton, 2004; Sack, 2001).

I would want to argue that attention to the problem of scale in the context of internet-enabled many-to-many communication constitutes a formidable challenge to both technologists and democratic theorists.

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Survey Research and the Future of Internet Diffusion

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In the 2002 Communications White Paper, the British Government spelled out its commitment to achieve universal access to the Internet by 2005 (http://www.communicationswhitepaper.gov.uk/). The 2003 Oxford Internet Survey (OxIS) found that 59 percent of Britons had access to the Internet; the figure is expected to have grown in 2005 but it is likely that access is still far from universal. Predictions about the development of Internet use often work on an underlying assumption of the inevitability of Internet diffusion along a straightforward and predetermined path towards universal access both across societies and social groups. However, there is a fundamental problem with these futuristic predictions: they operate in a social void in which the technology impacts on society following an inner logic of its own and where people are passive recipients of technological change. Thus, modernist approaches of this kind often lead to the development of either utopian or dystopian predictions about the evolution of the Internet and its social implications. The result is a black and white reality where the Internet will have either good or bad outcomes: it will either act as an empowering and democratising force or it will further exacerbate existing inequalities and contribute to an increase in control and surveillance and an ensuing loss of freedom.

Existing social research shows that these deterministic assumptions cannot be taken for granted. The Internet is not like any other utility. It is a dynamic technology which is constantly evolving, continually requiring people to keep up with the equipment and skills needed to make optimal use of it. Due to its interactive nature, the Internet both shapes social practices and is shaped by individuals who creatively contribute to its content. Thus, a mere focus on the capabilities of the technology itself is a poor predictor of future developments. We need both conceptual and methodological tools that can enable us to identify the complex interplay of social, cultural, economic and technical factors which shape both access to the Internet and the outcomes of Internet use. One of the most powerful tools employed by the social sciences for this end is survey research.

While collecting data on Internet use and diffusion is not unproblematic, in the past few years a considerable body of evidence has been gathered via surveys on Internet use within and across countries. Existing survey research both in Britain and abroad has highlighted the differences in Internet access between different social groups and across countries. While certain gaps are closing in certain countries (i.e. the gender gap in the US), others such as the gap between older and younger people are persisting. Evidence from the 2003 Oxford Internet Survey shows that while 98 percent of people of school age use the Internet, 80 percent of retirees do not—a finding that the World Internet Project has shown to be common to many other countries (http://www.worldinternetproject.net/).

However, as Internet use becomes more widespread the notion of a simple digital divide between ‘have’ and ‘have nots’ is being quickly surpassed by a more complex reality in which people drop in and out of use—what Lenhart *et al.* (2003) have aptly termed the ‘ever-shifting’ Internet population—and in which some people consciously decide not to use the technology. The path to universal access is after all not as linear as modernist theories predict. Evidence from the 2003 OxIS survey for example shows that Internet experience can have double-edged effects. The more people become familiar with the Internet, the more trusting they become. However, higher proximity can lead to more negative experiences, such as a higher exposure to SPAM, viruses or unwanted materials, which can in turn lower trust in the medium (Dutton and Shepherd, 2003). Because of their negative experiences with viruses and spyware, there are growing numbers of people who are giving up use of the Internet (LA Times, 14/1/05). Other people are simply losing interest or do not see the value of using the

Internet: in South Korea, email use has been dropping dramatically among teenagers who are increasingly turning to communicating via SMS messages on their mobile phones instead (The Guardian, 7/3/05).

By uncovering these 'unintended' and 'unanticipated' consequences of Internet use, survey research such as OxIS has made a chief contribution to existing theories of Internet diffusion by showing that the concept of '*digital choice*' is becoming a much more relevant conceptual and methodological tool than the concept of '*digital divide*' in making predictions about social change. These findings have powerful policy implications, as they suggest that efforts should not only concentrate on trying to remove barriers to access but also on keeping existing users happy. New pressing questions need to be answered: will drop-outs eventually come back to the Internet? How do we ensure that existing users see the value of using the Internet in their everyday life and will not drop out in growing numbers? How do we entice non-users to adopting the Internet?

Survey research plays a major role in answering these questions, as ISPs, governments and businesses need to know more on the ways people use the Internet in order to formulate their policies and marketing strategies. Indeed, there is a growing awareness that as the technology itself continues to evolve and change, there is a need to move to a 'second stage' of Internet research by shifting the focus from the resources needed to access the Internet to *how* and *why* people use the technology. As people will access the Internet via mobiles and PDAs in growing numbers, will this contribute to more fragmentation and people dropping out or will it increase the number of users? How will the spread of broadband transform the Internet and its uses? What are people's motivations in using the Internet? Does the Internet provide people with the information they are looking for? Are people satisfied with the information they find online? Do they trust the information they find? And more importantly, is the Internet mainly used for information seeking and providing, or for communication and entertainment? All these questions show the relevance of a 'social informatics' approach (Kling, 2000) to the study of Internet diffusion. While empirical research of existing trends might not be the best tool to forecast what people will do in an abstract distant future, it remains fundamental in enabling policy makers and technology developers to make informed decisions and educated predictions about the future of the Internet. Thus, the study of emergent technologies cannot but benefit from a multi-disciplinary approach.

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Notes on Pitfalls and Challenges for Research on Emerging Information and Communication Technologies: Lessons Learned

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In joining a new discussion of approaches to research on emerging information and communication technologies (ICTs), like the Internet, it is useful to remind ourselves that the challenges facing this work are not new. The early development of computing spawned much speculation on its long-range societal implications. Most centred around its primarily arena of application outside the military, business and management. Leavitt and Whistler's (1958) early work on information technology (IT), defined as the convergence of computing, telecommunications and management science techniques, is a primary example. Broader empirical work arose around issues of privacy, such as with the Westin and Baker (1972) studies of databanks in a free society, which continue into the 21st century with debates over national identity cards.

It might be useful to suggest some of the pitfalls and challenges that have faced research in this area, as they are likely to be of continued relevance in organizing debate and research on these issues. However, before raising these points, it is important to recognize the range of topics that might fall under the umbrella of new approaches to the study of emerging ICTs. This helps bracket the focus of our discussions.

I find a simple typology of topics (see Table) to be helpful in defining different topic areas. We can use old or new methods to study the use of old or new ICTs. I am assuming that this workshop is focused on the use of new or old methodological approaches to the study of emerging, new ICTs. Rather than focus on methods, I propose that we focus on exploring useful approaches to the study of specific emerging technologies, drawing from a large array of new and old methods of social inquiry.

	Old ICTs	New ICTs
New Methods	Webmetric study of invisible colleges	Webmetric study of the impact of the Grid on scientific collaboration
Old Methods	Co-citation analysis or survey research on invisible colleges	Interviews with e-Science researchers on the role of the Grid in scientific collaboration

The focus of this meeting, on new ICTs, rather than methods, suggests that we spend less time discussing some fascinating challenges, such as the ethical issues of research using new ICTs, and more time on the general framing of the research questions and broad approaches. This leads me to identify the following as possible topics for discussion:

Attention Deficits and Cycles

Interest in emerging ICTs has been enduring, but there are wide variations in attention across technologies and over time.

Technologies

Some technologies do not seem to generate the same levels of interest and research as others. Compared to the mobile phone, plain ordinary telephones (POTS) did not generate as much wide-ranging debate and research on its social implications (Pool). The pager generated almost no social science research (Dutton et al., 2001), while the Internet has yielded volumes of research.

There seems to be a deficit of attention to 'little' technologies, like texting, as compared with 'big' technologies, like embedded sensor networks. This is despite the fact that huge investments lie behind the design and delivery of these simple services, like the phone or text messaging, but they appear to be incremental or taken-for-granted, and less often targeted by research.

Over time

There are predictable cycles of attention and inattention to particular technologies. The so-called 'hype-cycle' provides one illustration of the recurring patterns of (in)attention to new technologies. Interactive cable generated much interest in the late-1970s and early 1980s, but is virtually forgotten today. As if searching for the end of a rainbow, the focus of researchers keeps moving further into the horizon. At a recent discussion of computing and the public, a participant put this attention problem well in suggesting that there is a paradox between the remarkable and the mundane.[7]

These attention deficits and cycles create a major problem for the development of a sustained and cumulative body of research. Compared to the study of elections, which are recurrent and never ending, the study of ICTs seems to require continual reinvention.

An Interest in the Future

Many fields of the social sciences seek to explain past and contemporary events and processes. Most interest in the social implications of ICTs is focused on the future. Political scientists are often content to ask: Why did the public vote for a candidate or party? And political party activists seem interested in the answers. ICT researchers are often less content to ask: Why do people use a particular technology, a question that veers toward market research. And government, business and industry often seem less concerned about the answer. People are interested in the future of technology and the resultant social implications. Of course, social scientists along with others have a very poor track record in forecasting the future.

A future orientation does not undermine social research on ICTs, but it raises many needed debates over appropriate or best approaches. Some advocate drawing from futures' research, such as reasoning by analogies. Others, such as myself, argue for empirical research, such as on studies of leading-edge developments that are well implemented, to gain some empirical anchor to future uses and impacts. But in all cases, we are less often interested in

[7] Anon. Meeting of the British Computer Society on Public and Government Engagement with IT, House of Lords, London, 5 April 2005.

averages, or central tendencies, but on directions of change or the potential for transformation.

The Importance of Time Horizons

The problems of a future orientation depend in part on the time horizon. Emerging ICTs can be defined broadly, to incorporate a wide range of technologies, but approaches to research can vary, depending on the time horizon of emerging technologies. There are three general categories of horizon, which I'll call changing technologies, emerging ICTs and future technologies.

(1) **Changing ICTs**. The Internet has arrived, but it is constantly evolving, such as with the advent of broadband and WiFi. In such cases, the central problem is studying a moving target.

(2) **Emerging ICTs**. There is more interest often in new, emerging technologies, which have yet to reach a significant segment of the target user group. To many, the Internet is an old technology. They are interested in the Grid, or other new technologies, even though I argue that the Internet is quite encompassing of technologies, being defined in our Institute as a 'network of networks'.

(3) **Future ICTs**. The most fascination surrounds imagined technologies that have yet to be designed or implemented. Again, the concept of wired cities of the 1970s generated great interest, but interest diminished rapidly by the market failure of interactive cable TV in the 1980s.

Multidisciplinary Divides

The most fundamental challenge to research on emerging ICTs is the difficulty in bridging multidisciplinary perspectives. Within the social sciences, there are major divisions between the disciplines of psychology, sociology and economics, for example, in the kinds of factors shaping technological change and its social implications. Overlaying these divides are methodological differences between the formal modellers, such as game theorists, quantitative empirical researchers, such as survey researchers, and qualitative researchers, such as ethnographers. However, the gulf between engineers and computer scientists, on the one hand, and social scientists on the other, is perhaps the major challenge facing work in this area.

This divide is in part a difference of knowledge bases. In a collaboration on e-government, it is typical for a computer scientist to say that the political scientist knows nothing about the Internet, while the political scientist will respond that the computer scientist knows nothing about government. This might be the foundation for a useful collaboration, but it often marks the beginning of the end of collaborative work.

However, it is also a divide over approaches to the study of emerging technologies. Engineers and computer scientists are more often wedded to logical reasoning about technologies, leading them to extrapolate likely social consequences stemming from the technical features of ICTs. Social scientists are more likely to rely on empirical observations and an inductive logic, making them less comfortable in speculating about the social implications of emerging technologies, for example, but also less capable of forecasting the social implications of an emerging technology.

This distinction relates to the theoretical division separating many computer scientists and engineers, who view technological change as an independent force that is changing society, and social scientists, who more often view social forces—economic, legal, sociological—as independent forces shaping technologies and their social implications. Sometimes, at the

extremes, this can be characterized as a struggle between technological determinists and social determinists, but degrees of separation divide individuals along this dimension even when they veer far from an overly simplified determinism.

This seminar represents a major step in bridging these multidisciplinary divides, and exploring many of these other challenges for social research on emerging ICTs.

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The Use of ICTs in Teaching and Learning in Education

Rebecca Eynon

Current studies based in the social sciences that explore the use of educational innovations in schools, colleges and universities can contribute to research on the social implications of emerging technologies. Typically such research explores how the innovation of interest is used in practice and the consequences this has for the staff, students and institutions in which such work takes place. The findings of this research are designed to be of value to developers, practitioners and policy makers to assist the development and implementation of future e-learning initiatives. Research from individual case studies can be applied by practitioners to their own situation, and once a collection of high quality research has been carried out, general concepts and theories can be developed that can be applied to other educational contexts and technologies (Kling, 2000). Though the process from the development of the project to the dissemination of the findings takes several years, the work is still valuable, as the adoption of educational innovations tends to be far slower than predicted. Even though a technology may no longer be at the cutting edge, for many individuals and institutions such technologies may still be new and thus such research is relevant and valuable (Woolgar, 2002).

However, though such work can contribute to research on the social implications of emerging technologies it is fair to say that the time lag between the start of the study and the dissemination of the findings means that by the time the research process is completed, the emerging technology is unlikely to still truly be defined as such. In particular, developers and policy makers wish the findings of such research were made available far more quickly in order to be more valuable in their own work. Indeed, it is possible, through greater collaboration and slight changes in approaches to the ways research is carried out, for this goal to be achieved.

Through improved collaboration, dissemination and attention to the history of research in this area, researchers would be able to make more informed judgements about what the implications of an emerging technology are likely to be. Researchers in e-learning tend to treat each technology as totally new and develop concepts and theories without remembering what has gone before. We seem to forget the past each time a new technology is developed; policy makers make overly simplistic judgements about the positive impacts of the technology and at the same time researchers forget the work that has gone before and reinvent the methods and debates of the past. Greater collaboration with other researchers and stakeholders from a variety of backgrounds including social science, engineering, computer science, future studies, law and others, could be very powerful in making intelligent predictions about likely social implications of emerging technologies; bringing together those with research and experiences of micro levels of practice with those who are involved in more macro levels of research and policy. Through such sharing ideas of ideas and building on previous research more fully we would be better equipped to make intelligent predictions about the social implications of an emerging technology; suggesting how, for example, an e-learning innovation is likely to be adopted and the positive and negative consequences it may have for staff and students. Indeed, changes that have occurred in instances of e-learning tend to be less dramatic and straightforward than those predicted. The implications of the use of a new technology in teaching and learning are highly varied and complex, with positive and negative consequences for all actors involved within the educational process.

A second possibility is to explore how a particular technology could be used in education far earlier in the development process. Typically, e-learning researchers wait until a technology has been, or is about to be, adopted by an educationalist and/or an institution to study the

phenomenon. An alternative that is achievable via greater collaboration between all those engaged in researching and developing e-learning initiatives would be to employ more action-based research, where educators are taught to use a prototype technology and then asked to apply it in their practice (for example, see Yoong and Pauleen, 2004). Researchers would explore this process and the outcomes of the implementation would be made available to all interested stakeholders. In this way, a productive cycle of research, practice, development and implementation could take place.

For these ideas to be productive in practice there needs to be higher levels of commitment to multidisciplinary research and funding opportunities that can facilitate this process. How this can fruitfully be achieved is an open question.

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Software-sorted geographies

Professor Stephen Graham

An e-print of this pre-publication paper is available at:
http://eprints.dur.ac.uk/archive/00000057/

Pervasive Computing—A Case for the Precautionary Principle?

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The results of EMPA's four-year research program 'Sustainability in the Information Society' (www.empa.ch/sis), co-funded by the ETH board, suggest that precaution is necessary in the ICT field. In particular, we advocate precautionary measures directed towards *pervasive* applications of ICTs (Pervasive Computing) because of their large potential impacts on society (Som et al., 2004; Hilty et al., 2005).

Assessing a technological vision before it has materialized makes it necessary to deal with two types of uncertainty: first, the uncertainty of how fast and to which extent the technology will be taken up and how it will be used; second, the uncertainty of causal models connecting technology-related causes with potential social, health or environmental effects. Due to these uncertainties, *quantitative* methods to evaluate expected risks are inadequate. Instead, we developed a set of *qualitative* criteria based on the precautionary principle and on the principle of sustainable development (Hilty et al., 2004).

The following potential negative impacts of Pervasive Computing on society were identified:

- restriction of consumers' and patients' freedom of choice,
- stress caused by time–rebound effects and by unreliable technology,
- a 'dissipation' of responsibility in computer-controlled environments, and
- threats to ecological sustainability.

Since RFID technology is one of the forerunners of Pervasive Computing, and as such is expected to play an important role in daily life in the near future, we have assessed some 'smart label' scenarios in additional studies (Oertel et al., 2005; Kräuchi et al., 2005).

Based on these results, our position regarding the nine questions proposed is as follows:

- *The nature and management of Internet identity: What policing and accountability would be appropriate for users on the Internet who are in a rich space of identifiers that is evolving towards revealing more about their identity?*

  The problem of potentially person-specific data: Many data traces people create today by surfing on the Internet, by using cellphones, credit cards etc. could later be combined and recognized as referring to the same person. The higher the density of data traces people create by everyday actions, the more difficult will it be for them to act in different spheres with different (partial) identities. This is particularly the case if and when 'the Internet of things' becomes real, which means that acting in the real

world (without consciously using any computer) also creates data traces.[8]

As long as the virtual world (the world of data) is separated from the real world (the world of physical objects), Internet identity is a manageable issue. However, a real challenge arises if the two worlds converge.

- *Trust and loss of confidence: What tools and user interface redesigns can address the problems raised when Internet users cannot be sure of what they see on their screens, such as emails pretending to be from someone else or data from a 'Googled' source?*

Mutual authentication is technically solved (e.g. challenge–response procedures), but it is inefficient from the user's perspective. I don't think there is a way to escape the basic trade-off between security and efficiency in ICT. 'Because the systems that we use are becoming more and more complex, the user is increasingly forced to trust them blindly in order to be able to use them efficiently' (Klaus Brunnstein, IFIP President, 2002).

- *Giving everything a presence in cyberspace: What would be the implications if a person could 'look at' an object in the real world while 'seeing' its cyberworld manifestation, such as buildings linked to a list of tenants or vending machines to online payments?*

(1) In the long run, this could replace the rich information about objects that is embedded in the real world (signs, attached instructions, etc.) and force people to use this technology who did not intend to do so. In the extreme case, people would feel 'blind' without cybergoggles (or whatever terminal devices would be used). This would also make society vulnerable (the necessary ICT infrastructure could fail for technical reasons or be attacked).

(2) This augmented way of looking at objects would also create data traces in cyberspace (because access operations can be logged) and rise privacy problems.

- *A universal location infrastructure: Can we understand the implications, and offer guidance to the design and use, of a system that builds on a Global Positioning System (GPS) infrastructure to allow a device or person to always know 'where it is'?*

It will soon be possible so sell devices of the size of about 1 cm^3 which their owner can trace in geographic space using his or her mobile phone (the device is a combination of a GPS-like receiver and a data mobile phone). These devices can e.g. be sold as keychains: you will always know where your key is, no matter how far away. It will be easy to attach such 'key finders' also to cars, suitcases or other objects in order to trace people's locations. There will also be technical countermeasures (detectors etc.).

The concept of location privacy will have to be re-negotiated in society. This new technology, like many others, will have to be integrated in our culture, i.e. linked to existing standards of moral behaviour.

- *The personalised experience: Would the ability to totally personalise experiences, products, and services lead to a growth in 'gated communities' and intellectual in-breeding and extremism? Could outcomes be shaped in different directions?*

[8] For example: Some car manufacturers build microchips into car parts that record their history. These data are specific for the car, not for the person, and used for maintenance and liability purposes. However, they could easily be related to the person driving the car and used for surveillance purposes.

That would mean that cyberspace would experience a development in the opposite direction to the globalization that happens in the real world. An underlying assumption is that virtual communities would be more important than the physical environment we live in. This assumption seems doubtful, because physical presence is unlikely to lose its role as major source of mutual motivation for people.

- *'X-ray' cyber-glasses: If you could put on special glasses to see computer models overlaid on a world rich with sensors feeding those images, what would be the social and psychological issues that would need to be addressed?*

The same comment as to *Giving everything a presence in cyberspace*, and an additional issue here: Who will be in control of the content (i.e. decide about the models used)? It could become difficult to find out who is responsible (and can be made liable) for a damage occurring based on the mixture of real- and virtual-world data that will guide human action. E.g. in surgery, traffic and other safety-critical areas.

- *Leaving no user behind. How can all sectors of society, including the 'cyber illiterate' and users with disabilities, be given the opportunity to become effective e-technology users?*

The idea of bridging the so-called digital divide (giving everyone the opportunity to participate) should always be combined with the idea of the freedom of choice. 'Leaving no user behind' should not promote a world in which everyone is forced to use ICT, in particular not any specific ICT products. Unlike written language, which is a common good in our democratic culture, ICT is still (and increasingly) dominated by proprietary standards and particular interests. As long as this is the case, I would like to suggest not to use the term 'illiteracy' in the ICT field.

In the long run, the problem of maintaining the freedom of choice and open competition in the ICT market will become more severe that that of leaving no user behind.

- *Global variation in the Internet experience. What mechanisms can address different national approaches to Internet use, such as regulations that implement a technological capability like Internet 'wiretapping' according to different laws.*

Like environmental policy, Internet regulation policy has to be global to be effective. National regulations may have the effect of raising awareness, contributing to the debate, giving examples, but effective regulations (if any) need international agreements and institutions.

- *Rules for surveillance in cyberspace. What should be the rules in cyberspace equivalent to those evolving for surveillance cameras, such as posting a warning of their presence.*

There could be a general rule like 'don't read information without leaving a message that you have done so', but implementing this would have enormous consequences, could require a different technology (in terms of software architecture, maybe even hardware architecture).

From today's perspective, it does not seem to be realistic that rules for surveillance in cyberspace can be implemented in a trusted way. We will live with the risk of surveillance. A much greater problem arises when the virtual world merges with the physical world, because it is (more or less) possible to escape from the virtual world, but not from the physical world.

- *Bottom-up distributed monitoring. With the falling cost of sensors that can be linked to the Internet, what would be the personal and legal implications of the sort of data that might be gathered by sensors owned by private individuals and groups?*

Sensor networks: This is one aspect of the convergence of virtual and physical world, making the conventional concept of privacy practically impossible to implement.

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Position Papers on Universal Location Infrastructure

Shirley Hung, Spencer Lewis, Jon Lindsay, Christine Ng and Kenneth Oye

One set of issues worth discussing at the OII–PoET Workshop center on the implications of technologies that locate devices and people and technologies in geographic and virtual spaces, and of technologies that may enable or block the use of such technologies. The position papers below move down four tracks.

1. IP Addressing and the Link between Virtual and Geographic Location

An IP address provides (limited) information on how virtual locations map into geographic space. The paper by Shirley Hung provides a briefing on reverse tracing of packets of information to a precise physical location, with discussion of how anonymous routing, fake IP addresses, and wifi may limit tracing. The paper also describes briefly the interests and activities of regulators, law enforcement, commercial interests, and ordinary users in regulation of this key interface between the virtual and physical worlds.

2. RFID and Geographic Location

RFID technologies taken with associated networks of sensors provide data on the location, identity and other properties of devices and people. As RFID applications move from inventory tracking to a ubiquitous presence in transponder-based toll collection, identity and credit cards, and consumer devices, the volume of data generated on individual location and behavior is increasing geometrically. The paper by Christine Ng looks back at expectations regarding implications of RFID, and uses that retrospective assessment to flag issues on prospective use of RFID-based systems.

3. GPS and Geographic Location

The call for position papers used the example of a GPS-based infrastructure that would allow a device (or person) to know 'where it is' under all circumstances, and suggested that the OII–PoET workshop might focus on ways of assessing implications and offering guidance on the design of such a system. The paper by Spencer Lewis with contributions from Christine Ng provides a look back at expectations regarding implications of GPS, and uses that retrospective assessment to flag issues on prospective uses of GPS-based systems.

4. Who Lives at this Address

Jon Lindsay notes that IP addressing, RFIDs, geographical coordinates, social security numbers, phone numbers, and nearly any other addressing scheme all involve a relationship between a standardized piece of information and some place, person, or thing in the real world. Maintaining this referential relationship requires engineering and institutional work, and his memo describes some of the many things that can go wrong.

The workshop may wish to focus on larger issues raised by these papers on technologies that provide information on location, including:

- What are some key sources of uncertainty with respect to the evolution of these technologies of location and their application? To what extent are technical systems designed with appropriate sensitivity to these sources of uncertainty and adaptive capacity?
- Will the revolution in decentralization of sensing technologies in embedded networks be accompanied by decentralization of processing technologies? Or will centralized private and public processing nodes be empowered and overwhelmed by floods of information?
- What are the real or imagined tradeoffs between security and individual privacy? Does the sheer volume of information being thrown off by these technologies jeopardize privacy, or produce so much noise that individuals may gain a measure of privacy through obscurity, complexity, and the ability to submerge themselves in the information flood?
- How may regulation of such possible tradeoffs between security and privacy affect infrastructure development and commercialization of technologies?
- Should individuals possess the right to control who has what information on their location by turning on or off GPS and RFID devices or by enabling or disenabling IP address tracing?
- How are European, American, and Japanese regulatory systems currently responding to the broader security, economic and societal issues flagged above? To what extent are current regulatory systems designed with attention to sources of uncertainty over broader issues and adaptive capacity?

IP Geo-Locational Tracking

Shirley Hung

At present, the ability to locate a computer's physical address through IP addressing is quite limited. The fears that one hears about damage to privacy, location-based spam, and tracking do not apply to the same degree for computers/IP addresses as it does to cell phones/GPS-implanted devices, RFID tags, etc. Contrary to Hollywood movies, for the most part it is impossible to trace, particularly in real-time, the sender of a particular packet of information to a precise physical location. The reverse-tracing system breaks down at the 'last hop'.[9] Traceability depends on record keeping: does the ISP keep track of where/to whom it assigned a particular IP address, and do they keep records? Ultimately, it also depends on physical monitoring, since the true objective is not merely physical location but physical location *and* the user, and one cannot necessarily determine the user even if the computer is known. It would seem that at present, the ability of a computer-savvy criminal to evade identification through his online activities far exceeds that of law enforcement to catch him. In other words, the interface between the electronic and physical worlds provides an advantage to he who wishes to remain anonymous; the breakdown at present is in the physical world.

Who cares?

- Regulators: taxation of e-commerce, restriction of access (Yahoo! France and Nazi materials); censorship (Google China).[10]
- Law enforcement.
- Commercial uses: regionally based advertising (Google ads based on location); finding geographically close mirror sites; traffic flow analysis; ISP decisions on where to deploy new infrastructure;[11] blacking out of sporting events, gambling, IP rights (movies, etc.), websites with international clientele,[12] etc.
- Individuals: civil liberties, privacy, not getting spammed.
- VoIP: emergency response.

Historical perspective:

- Fixed locations and limited numbers of computers made tracking comparatively easy—computers did not move, and kept the same IP address.
- All access through telephone system (modem dialups), and telephone lines were fixed. This meant one could trace through either the

[9] Richard Clayton, 'The Limits of Traceability'. Accessed at: http://www.cl.cam.ac.uk/users/rnc1/The_Limits_of_Traceability.pdf

[10] http://www.technewsworld.com/story/38573.html. TechNewsWorld (Dec. 1, 4) 'China is censoring Google News to force Internet users to use the Chinese version of the site which has been purged of the most critical news reports,' said a statement from Reporters Without Borders. 'By agreeing to launch a news service that excludes publications disliked by the government, Google has let itself be used by Beijing.' ... 'It is actually a form of geolocation filtering since users who access Chinese Language Google News from anywhere but China are not subjected to the filtering and receive full search results,' Villeneuve told TechNewsWorld.'

[11] Andrew Turner, Geolocation by IP Address, Linux Journal (Oct. 2004), quoted in http://www.cybertelecom.org/notes/geolocation.htm

[12] http://www.siliconvalley.com/mld/siliconvalley/9119094.htm

financial information given when the ISP account was opened, or through the telephone number. IP addresses were assigned each time, so one only has to go to the telephone company with proper authorization, determine the telephone number used, and trace it to the physical location. Possible complications:

(i) Caller ID blocking, international calls (Caller ID often does not transfer), generic numbers (as with large telephone exchanges for discount phone cards—then it's a question of logging).

(ii) Use of dial-ups in other states, other countries, etc.

(iii) Cellular telephones—creates problem of tracking location of cell phone.

(iv) Disposable cellular telephones—ditto above, but with additional complication of lack of billing information for owner of cell phone.

- Designers of IP addressing system (DARPA) never imagined current worldwide spread of Internet or demand for as many IP addresses as we need now.

(i) There is a debate over whether or not we've actually run out of IP addresses. Some argue we functionally began running out in 1992, when registries starting clamping down on space. Then again, with about 4 billion possible addresses and only about 70 million in active use (and about half of all possible addresses already assigned), maybe not. Stanford actually gave back (!) its Class A block of about 16 million addresses, keeping its four Class B blocks.[13]

(ii) Movement from shift from IPv4 to IPv6 to free up more addresses, among other concerns.

How IP addresses are organized (technical information):

- The entire collection of IP numbers is managed by the Internet Assigned Number Authority (IANA) under the authority of ICANN. IANA then delegates large blocks of numbers and assignment responsibilities to Regional Internet Registries (RIRs), including: American Registry of Internet Numbers (ARIN <www.arin.net>), Asia Pacific Network Information Center (APNic <www.apnic.net>), RIPE Network Coordination Centre <www.ripe.net>, Latin American and Caribbean IP address Regional Registry (Lacnic <www.lacnic.net>), and AfriNIC <www.afrinic.net>. These RIRs are then assigned large blocks of numbers to either large networks such as universities, large corporate networks, or ISPs/Internet backbones.[14]

- An Internet Protocol address consists of four numbers, each between 0 and 255, separated by periods. The first number signifies the computer's geographic region; the second number a specific Internet Service Provider; the third a specific group of computers; and the fourth a specific computer within that group. (This actually varies slightly, but not for functional purposes, depending on whether it's a Class A, B, or C address.)

What's possible now:

[13] http://www.nwfusion.com/news/2000/0124ipv4.html. MIT, to the best of my knowledge, is holding on its Class A block with an iron deathgrip. Yay for status symbols.

[14] http://www.cybertelecom.org/dns/Ipv6.htm

- Two ways to look up physical location of IP address:

  (i) Reverse DNS (domain name service): The DNS is the ISP-assigned, human-readable name of a numerical IP address. After looking up the domain name, which often reveals information about physical location, use host program to do a reserve-lookup for more detailed information.

  (ii) Use WhoIS, a public registry database operated by ARIN.

- Various Reverse IP address lookups (TraceRoute, Ping, Trace, WhoIs, etc.) can, based on information provided by IP registrars, determine country and often city—though this is not always accurate, depending on how the ISP has registered their addresses. For example, a nation-wide ISP may register all of their IP addresses to a particular city, or addresses in a suburb may appear to be coming from the nearest major city. (For experiment's sake, I used one of these services to find where I was—and was told that I was in Randolph, MA when I was in Boston.)

- Accuracy for these reverse lookups right now is pretty limited. Figures I have seen run something like 95% for country, 70% for region, and 65% for city.[15] My experience and that of many others, particularly those outside the US, is that these figures are rather inflated.[16]

- One can, based on IP address (the first 8–24 numbers of a 32 digit IP address) determine the ISP, but beyond that point, it is up to the ISP to determine and log who has any particular IP address at any given time. The ISPs may or may not keep records of this information.

Technological Obstacles and Complications to Geolocation:

- Mobility: System was not designed for tracking moving computers; mobile computing was not anticipated.

- Wireless access/WiFi networks and hotspots + DHCP and other temporary IP address assignations.

  (i) Most WiFi networks are not secured, so anyone with a wireless networking card can get Internet access.

  (ii) Difficult for owner of unsecured network hub to know who's using their connection at any given time. Many do not keep logs. The phone company might be able to tell you that an IP address was assigned to someone in Apartment A, but cannot tell you that the neighbor in Apartment C next door is the one using the connection. The NYT recently (finally!) reported on this topic.[17]

  (iii) With increase in number of HotSpots (and therefore number of users at a particular hub, with a greater geographic spread of users because of increased signal strength), this becomes even more complicated.

  (iv) *An illustration*: In a large network (especially over large physical domain), if the provider keeps a rather detailed log, he might be able to tell you a particular IP address was given out at 3pm from the hub in 10–250 and

[15] http://www.ip-to-location.com/README-IP-COUNTRY-REGION-CITY.htm#17

[16] http://slashdot.org/article.pl?sid=02/01/04/1258255&mode=nested;%20

[17] http://www.nytimes.com/2005/03/19/technology/19wifi.html?ex=1268888400&en=51d90e7518bba5d6&ei=5090&partner=rssuserland

disconnected at 4pm. This answers the *where* question. For *who,* the network administrator might be able to tell you the number assigned to the Ethernet card that used the IP address. Beyond that, you would need either a log of who owns an Ethernet card with a particular number (useless in the case of public terminals), or a witness to tell you who was in the room at that hour. If there were multiple people using wireless connections in the room at the time, however, you're out of luck.

(v) These problems have been recognized by the legal system—reliability (and plausible deniability) of purely electronic evidence is problematic. Hence why following suspects becomes necessary.

- Anonymous routing/onion routers, with additional complications.

(i) Anonymous routers in other countries: international laws make it difficult to find the owners and compel them to give up information—assuming they keep records at all (the point of an anonymous router being to not keep logs).

(ii) Serial anonymous routing: just to make it more complicated, send your message through several of these.

(iii) Encrypting (repeatedly) messages: and encrypt them along the way, using a different key each time, just so that in case they somehow manage to trace your message, they still can't read it.

- Fake IP addresses (assuming you don't need a reply to your message, this is entirely possible to do). The IP address is precisely that: an address. If you don't need to tell your correspondent where to send information, then their knowing where you are is unnecessary.

Tradeoffs and considerations:

Geolocation is not all good or bad. There are both pros and cons to being able to locate a user through their IP address. Issues that come up, therefore, include but are not limited to:

- *Who* has access to this information? Under what conditions and with what authority? Who decides this question?
- *Specificity.* How detailed must tracking ability be?
- *Control.* Can the user opt out of geo-tracking? Can s/he mask their location?
- *Security.* How to secure private information?

What law enforcement is up to:

- G8 has been working on trying to get regulations passed requiring data logging and data retention by ISPs and telephone companies.
- The US Supreme Court is dealing with the issue of community decency laws based on Internet pornography: it has determined that since Web providers do not have the technological ability to restrict access to users at a specific geographic location. Several cases have been brought before the court that touch on this issue. It is unclear to me that they have reached any firm conclusions.

- FBI, DOJ, DEA working on incorporating VoIP into CALEA (Communications Assistance for Law Enforcement, 1994), better known as the wiretap bill.[18]

What others are up to:

- IETF has a Geopriv working group that has proposed several standards for re-configuring IP addresses to reflect geographic location.[19]
- Jabber proposal for the same.[20]

[18] http://www.cybertelecom.org/voip/Fcc.htm#calea

[19] See specifically http://www.ietf.org/internet-drafts/draft-ietf-geopriv-dhcp-civil-05.txt, alternate proposals are also available at http://www.ietf.org/html.charters/geopriv-charter.html under 'Internet Drafts' subsection.

[20] http://www.jabber.org/jeps/jep-0080.html

Pervasive Computing: Embedding the Public Sphere

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An abstract of this paper [Kang, Jerry and Cuff, Dana, 'Pervasive Computing: Embedding the Public Sphere'. *Washington and Lee Law Review*, Vol. 62, 2005], is available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=626961

Policy Innovation and Emerging Technologies

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What do emerging technologies mean for public policy-making and the capacity of government to innovate? In many countries we see increasing numbers of policy innovations dependent upon technological innovation (or, at least, innovative use of technology)—in the UK for example, the electronic tagging of prisoners, the London congestion charge, the 'Oyster card' ticketing system, road-pricing systems and new forms of immigration control. Such developments represent a break from the mere automation of government activity—but involve policy-makers thinking like technologists. Although the technology used may not always be particularly innovative, the policy-making itself becomes the development of large-scale technology-based projects that are probably distinctive in terms of scale, organisational context and heterogeneity of stakeholders.

As researchers, we know little about technologically fuelled policy innovation, while policy-makers themselves are often reluctant to admit the extent to which the process of policy-making has become so intertwined with technological development. Yet in the 21st century, technological innovation is particularly important to policy-making; while earlier technologies used by government have tended to be largely internal, contemporary technological innovations are more likely to facilitate or enhance government–citizen (G2C), government–business (G2B) or government–government (G2G) interactions. Meanwhile, for citizens, emerging technologies introduce confusion into their interactions with government if government fails to keep up with their adoption rates. And technology allows far more complexity in policy-making—for example in ticketing systems and road-pricing systems—yet becomes more opaque to citizens using it.

More importantly, policy-makers need to keep up with emerging technologies—they have to see into the future for two key reasons. First, they have to understand how the worlds of citizens and businesses are changing as emerging technologies are adopted. For example, if policy-makers were able to absorb the widespread penetration of text messaging (rather than either assuming it will be overtaken by some other technology or, preferably, go away) it might be more possible to interact with UK governmental organisations in this way. Second, major opportunities for innovation will be lost or mishandled if policymakers do not understand what might be possible for government itself to do in the future. While governments in the US and the UK led the private sector in developing information technologies in the 1950s and 60s, with the Internet, governmental organisations lag behind the private sector and voluntary organizations in terms of developing on-line interactions. Emerging technologies will shape the nature of government and its interactions in the future, a process that has already begun through the Internet. As government organisations 'become' their web sites, for example, then understanding government means understanding 'government on the web' (Dunleavy and Margetts, 1999, 2002). The development of 'web-metric' techniques and their application to the structure of governmental organisations will be important in understanding the relationships between governments, citizens and businesses and the nature of intra- and inter-governmental relations in the era of the Internet.

Policy-making may be broken down into two key tasks—detecting and effecting (Hood, 1983), terms taken from cybernetics to describe the 'two essential capabilities that any system of control must possess at the point where it comes into contact with the world outside'. In these terms, governments need to employ a host of detecting instruments ('detectors') to observe or to obtain information from the outside world. But no control system is worthy of the name unless it is capable of taking some action on the basis of that knowledge, and government must have some means of trying to adjust the state of the system to which it relates—'effectors'. Emerging technologies bring change to both these key tasks of policy-making, as

both detecting and effecting involve government in understanding how society is using or will use technological innovations, and using the emerging technologies itself.

In general, it seems to be easier for government to innovate with emerging technologies in terms of detection, particularly in terms of the use of mixtures of cameras and databases in traffic control and crime prevention. In general, government has been less good at either processing that information or using it in the business of effecting. So, for example, the databases of the London congestion charging scheme and Oyster ticketing system collect and retain huge amounts of information about Londoners' journeys. But it seems to be difficult for effecting processes to keep pace with detection. So, for example, when someone forgets to pay the congestion charge, they receive a letter by the postal system. If they then fail to pay the penalty, they will receive more letters followed by that most traditional, long-standing and non-technological activity of government—a visit from the bailiffs. Likewise, a great proportion of information collected on CCTV cameras is either unusable or never used, particularly for the more minor crimes which presumably it was introduced to reduce.

We cannot expect the distinctive challenges facing government as a user of emerging technologies that shape the ways that technologies emerge. But we can try to ensure that there are stronger bonds between policy-makers and technologists in terms of tracking the path. The place to start is research, so that researchers into emerging technologies make more effort to involve the 'right sort' of policy-makers, who won't just be those involved in telecommunications regulation or reducing the digital divide, but those working in any department of agency with high volumes of G2G, G2B or G2C interactions. In turn, these types of policy-makers need to interact with technologists and be more accepting of the big changes that have taken, are taking and will take place in the nature of their work.

Such interactions—which involve policy-makers understanding technology as much as technologists understanding users (the old cliché)—might avoid some of the pitfalls in the incorporation of technological innovation into policy-making identified by innovation research *per se*; for example, 'thin rational' models of policy improvement (Scott, 1998) and 'rationality gaps' (Heeks et al., 1999) in the development of government information systems. Such research suggests that innovations succeed if they go with the grain of existing practices, informed by understanding of the fine detail of social organisation in any given administrative context—both of which increasingly involve a wide range of new and emerging technologies.

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Interrogating the e-Society: Reflections on Research

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These reflections have been prompted by the experience of conducting a two year investigation into peoples' encounters with and relations to digital communication technologies. The project, *Navigating the e-Society: Dynamics of Participation and Exclusion* is one component within a wider programme of research on the e-Society funded by the ESRC. It has been co-directed by myself, Ruth Lister, Professor of Social Policy in the Department of Social Sciences at Loughborough University, and Karen Kellard, of the Centre for Research on Social Policy at Loughborough.

The research has tracked a sample of 93 UK households over two years

- chosen to represent a cross section of life circumstances stratified by income, life stage, household type, ethnicity , and rural and urban location

- using a combination of quantitative and qualitative methods to explore patterns of ICT adoption, access and exclusion.

Each household was visited twice over a period of eighteen months. All members of the household aged six or over were included in the study.

The analysis and writing up of the data generated by the project is still on-going. Consequently, rather than giving a necessarily partial summary of the findings I want to use this occasion to sketch out the general conceptual and methodological lessons that have emerged from the work.

From Technologies to Landscapes

Most research into ICTs to date has focused on the take up and use of particular technologies. Consequently we now have substantial research literature on internet access and use, a rapidly proliferating literature on mobile phones, and an emerging body of studies on digital interactive television. This work has generated valuable insights but because it has approached questions of exclusion, use, and change on a technology by technology basis it has not provided us with a comprehensive map of the overall digital environment. Our research set out to address this gap by examining how this emerging landscape appears to people and how they are navigating their way through or around the possibilities it presents and the problems and anxieties it generates.

Focusing on digital landscapes as constituted by ensembles of technologies immediately opens up questions of how the emerging relations between different ICTs are perceived and managed. Do people see them as complementary or in competition? Do they see them as substitutes, alternatives or additions? How, for example, do they see the relation between email and text messaging? How do they move between broadcast output as it appears on the television screen and the internet resources linked to programming?

Tracking Change: Innovations and Biographies

We are currently seeing a cluster of innovations and changes in the three digital communications technologies that have the greatest potential impact on everyday lives outside the workplace:

- In personal computing we are witnessing a migration from dial-up to broadband connections and the roll-out of wi-fi.

- The increasing popularity of camera phones and the launch of 3G services are taking mobile phones beyond voice and text and transforming them into multimedia systems.

- The popularity of Freeview is accelerating the shift from analogue to digital broadcast services and helping to embed 'red button' interactivity as a taken-for-granted dimension of television viewing.

As we noted above, these innovations intersect with each other to create both enhanced opportunities and more complex choices for users. But they are also being introduced into an environment in which everyday lives and relations are being reshaped by a range of general economic, social and cultural shifts. These include: changing patterns of inequality and deprivation; changing family structures and the rapid growth of single person households; the impact of new developments in security and surveillance; and the increasing individualisation and personalisation of media services. These structural shifts are reshaping, in fundamental ways, the terrain on which grounded social action takes place and the allocation of the core resources that support or inhibit options for action.

Consequently, to understand the impact of new ICTs we need to examine the interplay between the possibilities for action presented by emerging innovations and the shifting social situation of particular groups of actual and potential users.

From The Digital Divide to Digital Inequalities

Exclusion is not an either/or condition. It is a continuum. Taking Ofcom's working definition of media literacy and applying it to ICTs we can define full literacy as the ability to access, understand and use ICTs creatively in a variety of contexts. As this definition makes clear, access to a machine is a necessary but not a sufficient condition of creative, self-directed use. This requires in addition competencies in:

Navigation: the ability to use the core features of a technology such as how to move between the different sites on a web page and use hyperlinks.

Control: searching effectively for content, downloading and using appropriate software, knowing how to respond to routine machine failures, being aware of the range of software available including public domain options.

Origination: knowing how to participate appropriately in on-line discussions, knowing how to use the technology as a space and resource for personal expression.

If we define citizenship as the right to participate fully in social and cultural life and to help shape its future forms it is clear that capacities for control and origination are a basic prerequisite for the effective exercise of citizenship rights in the digital age. While users with navigational skills would be able to access and use the top-down options provided by corporations and state agencies they would not be able to participate effectively in the full range of possible self-directed uses or peer-to-peer exchanges.

Digital Careers

Access then is not, in itself, a guarantee of full ICT literacy. It launches the user on a digital career that has a number of possible outcomes, from remaining a basic and sporadic user, to becoming a more creative user, to disconnecting and dropping out. Tracing these career patterns and identifying the key factors that enable or determine particular outcomes is a key task for research.

Resource Clusters

Both initial access and subsequent career trajectories are crucially shaped by peoples' differential access to the three basic clusters of resources: material, social, and cultural.

Material Resources

Unlike a number of other goods, ICTs involve a range of expenditures:

- On the basic machine itself
- On additional peripherals and software to accomplish certain tasks in the case of home computers
- On connectivity to telecomms networks in the case of home computers and mobile phones and on an enhanced off-air aerial, cable connection or satellite dish for digital television services
- And increasingly, on payments or subscriptions to access particular services

Access to the full range of possibilities supported by digital technologies (particularly home computers) is therefore relatively expensive, which is why surveys continue to show a strong relationship between discretionary income and home computer ownership and to identify a substantial minority of the population on low incomes who do not have a machine in the house.

In addition to direct costs there are also opportunity costs: the costs of giving up or foregoing some other item (e.g. a family holiday, a new washing machine) in order to buy a home computer and be able to use it to its full potential.

Added to which, ICTs work with a relatively compressed expenditure cycle. Computers are rendered obsolete relatively rapidly and consumers are expected to upgrade or to make additional purchases in order to continue using their current systems. To use floppy discs or zip discs with most current laptops for example it is now necessary to buy external disc drives.

The link between discretionary income and ICT access and use is well established but our research identified two other material resources that can have a substantial impact: time and space.

Access to 'free' time is unequally distributed. Within households, women typically have less time 'to themselves' than men. In an increasing number of jobs, people are expected to take their work home with them, with the consequence that much of the time spent on the computer or mobile may be other-directed rather than self-directed.

Within households, the location of ICTs and the number of machines owned also has an important bearing on patterns of access and use. People are more likely to use a computer in a flexible and exploratory way if it is located in a room set aside for the purpose or a room that guarantees privacy than if it is in a 'public' room such as a sitting room. Perceptions of safe space also play a role in shaping peoples' use of computers in public locations such as libraries and community centres. Simply making a machine available to everyone who wants to use it in a public location somewhere within a five mile radius of every house does not in itself address the problems of differential perceptions of the quality, security and privacy of that space.

Social Resources

Issues around differential access to social resources are now being increasingly addressed in studies of ICT adoption and use. We can usefully identify two kinds of social resources:

- Access to friends, family members, neighbours or colleagues who can encourage or facilitate initial access and who can provide on-going help, advice and support. A number of the respondents in our study first acquired key items of ICT equipment as gifts or hand-me-downs and a number recounted the importance of having someone they trusted on hand to set things up, to trouble-shoot when things went wrong or to provide advice or instruction on how to master a skill they were not familiar with.

- Membership of social networks where digital technologies are used and valued. These certainly include localised networks based on regular face-to-face meetings but they may also extend beyond them to embrace migratory networks and groups based on shared interests. Examples include teenagers for whom text messaging has become integral to reaffirming membership of particular peer and friendship networks and ethnic minority households who have invested in digital satellite television to watch programmes from 'home' and to introduce their children to valued aspects of their culture of origin.

Conversely, not being integrated into such a network can be a powerful disincentive to access and use. As one elderly respondent remarked, there was little point in her having an email connection since no-one she wanted to talk had one.

Cultural Resources

This third cluster of resources is the least well researched, but in our study they emerged as more important that we had originally anticipated, suggesting that there is a gap in our knowledge here that needs to be addressed.

We can identify two main sorts of cultural resources:

- *Competencies* in the form of basic skills in reading, writing and speaking together with the ICT literacies discussed earlier. These can be taught. The same, however, is not true of the second main cultural resource

- *Identities*. Questions of identity emerged from our research as more important and more complex than we had anticipated, suggesting that they merit more sustained attention than they have received in studies of access and use to date. Two aspects in particular are worth pursuing further:

  Identification Firstly, there is the extent to which people feel 'at home' in the emerging digital landscape or estranged from it. Here, the promotional strategies of ICT firms may cut across the policy aim of encouraging universal access. Advertising for computers for example tends to feature machines being used either

by young professionals or by children and families. Very seldom does it show the elderly using the latest machines. There are sound marketing reasons for this but the result is a symbolic landscape which the elderly find difficult to recognise as a space constructed around their needs and requirements. It appears to them to be organised for the convenience of other groups. Nor is this process of symbolic exclusion confined to the elderly. It suggest that we may need to think again about the dynamics of self exclusion. When respondents say that they don't want a computer or a mobile phone because they 'can't see any point in it' or 'it is not for them' are they expressing a considered choice not to invest in these technologies, or are they signalling that they cannot recognise themselves as valued participants in these digital landscapes?

Self expression. Questions of identity also shape modes of use. We found many instance where ICTs were mobilised as vehicles for the construction and presentation of self. Take teenagers' relations to mobile phones for example. The expressed importance of design, style and personalisation (in the choice in ring tones for example) among our respondents pointed to the importance of sign values (what objects say about their owners) alongside issues of price and utility. The cultural meaning of objects has been extensively studied in social science work on other areas of consumption, but thus far it has not been explored in any depth in relation to ICTs.

Methodological Issues

In addition to raising questions about the way we conceptualise questions of access and use, our research also poses methodological issues, and by way of conclusion I would like make five suggestions for future work in area.

- *Sampling*. We need more studies that sample by household rather than by individuals, not least because personal patterns of access and use may be determined as much by the organisation of social relations *within* the household (by gender and generation) as by the overall social position of the household.

- *Combining methods*. We need more studies that employ both quantitative methods (pre-coded activity diaries, questionnaires) and qualitative methods (indepth interviews, observations, focus groups, open-ended diaries) with the *same* respondents in order to build up thicker descriptions of activities, beliefs, and motivations.

- *Innovative methods.* We need to be more adventurous in our mix of methods and in taking advantage of the options opened up by digital technologies. Possibilities include getting respondents to take digital photographs, make video diaries, and keep 'blogs' (web logs).

- *Tracking.* To better understand how innovations in digital technologies intersect with key biographical changes (redundancy, retirement, divorce, children starting school) and more general social and economic shifts we need to move from one-off surveys to panel studies following respondents over time.

- *Dissemination.* We need to digitalise our dissemination strategies by supplementing publications with interactive web sites and multimedia CD ROMs

Look Back—What People Wanted Out of RFID

Christine Ng

The most popularly cited historical summary of RFID's development is 'Shrouds of Time: The History of RFID', published by the Association for Automatic Identification and Data Capture Technologies, a trade association dedicated to promoting the growth of auto-ID and data capture technologies, which includes RFID, bar code, card technologies (magnetic stripe, smart card, contactless card, optical card), biometrics, and electronic article surveillance (Landt, 2001). As would be expected, their report generally has a very positive take on RFID. However, it does show how the perceptions of the uses of RFID have changed in the past few decades since it was first invented.

RFID derived its roots from a refinement of RADAR technology for military use during the World War II era. In the first real application of RFID, the British government used RFID to distinguish returning British planes from incoming German ones. This was distinctly different than RADAR, which could only detect the presence of a plane, not distinguish between different types. Identification friend or foe (IFF) transponders were attached to British planes to give them a familiar RADAR signal (Wireless Networks Tutorial, 2005).

The invention of RFID is attributed to Harry Stockman's 1948 paper, 'Communication by Means of Reflected Power'. The best graphical representation of the evolution of RFID applications, as they spread from R&D to government and military applications to commercial use, is based on the 'Shrouds of Time' summary: http://people.interaction-ivrea.it/c.noessel/RFID/RFID_timeline.pdf

The one RFID application that has captivated the public is the use of RFID tags to replace barcodes on consumer goods. The first RFID tags were invented in 1969 and patented in 1973. In the 1970s and 1980s, most of the interest in RFID was in tracking objects to combat theft or less. Major applications were electronic toll collection, animal tracking, and industrial and business processes (e.g. tracking items through the supply chain).

There is little writing on people's concerns about RFID prior to the 1990s, when the likelihood of widespread RFID use began to reach the public consciousness. Even so, most of the societal concerns about RFID have centered on individual privacy infringement, with the fear of being monitored by a 'Big Brother', whether that be the government, a corporation, or a personal stalker.

Today's Concerns

Extension of today's problems—RFID just makes it easier to interfere

One of the biggest concerns about RFID is the potential for sellers, government agencies, law enforcement, or other 'information collectors' to directly monitor consumers or users' activities. Arguably, this is already occurring through excessive and unwanted traditional mail and e-mail solicitations. Access to information from RFID systems would further exacerbate the problem, so the fears about RFID are really rooted in frustration with the unauthorized collection of consumer data and targeted marketing (Brito, 2004). Using RFID tags would likely increase the potential volume of information for collection, in terms of the number of consumers and the amount of details.

Indirect monitoring occurs when a third party secretly and/or illegally collects information about people who have consented to monitoring only by a specific group or set of groups.

Wiretaps, surveillance cameras, and computer hacking may be used to accomplish the same goals, but RFID systems may be more widespread and vulnerable to interference (Harper, 2004). If the cost of RFID readers goes down, unscrupulous individuals may use them to track the belongings or whereabouts of their unwitting victims.

A November 2003 position statement by 35 privacy and consumer rights organizations articulated critics' most common concerns. The statement calls for a voluntary moratorium on item-level tagging until a 'formal technology assessment' by a 'neutral entity' is conducted (Brito, 2004). It lays out the five reasons why RFID systems could threaten privacy:

(1) Ability to hide RFID tags without the owner or user's knowledge.

(2) Ability to hide RFID readers.

(3) Unique numbering of individual items.

(4) Databases containing unique tag data could be used to link people with objects.

(5) Ability to track or profile individuals without their consent.

Source: http://www.spychips.com/jointrfid_position_paper.html

Besides privacy

Although privacy concerns have dominated the news, RFID systems also draw concerns about energy consumption and waste disposal. Active tags have more capacity and reliability but they also require their own power source. If active tags become ubiquitous, their collective energy consumption, though small individually, will be a large strain on increasingly limited energy resources. If non-recyclable tags are attached to otherwise recyclable items, such as glass bottles or plastic packaging, it will create a problem for recycling facilities, which will have to remove the tags prior to processing or make costly changes to their recycling process (Kohler and Erdmann, 2004).

Regulation

Industry standard-setting

As early as 1973, there was already discussion about developing a national standard for US electronic vehicle identification. At a conference sponsored by the International Bridge Turnpike and Tunnel Association and the US Federal Highway Administration, attendees showed little interest in developing the standard. It may have been too early to settle on standard; by not standardizing, more technologies were allowed to develop (Landt, 2001).

Recently, standardization is occurring because of mandates by users, not by traditional standard-setting bodies like trade associations or government agencies. For example, in mid-2003, Walmart announced its requirement that its top 100 suppliers use RFID on every case or pallet by January 1, 2005; the same date is the deadline that the Department of Defense gave for the Pentagon's 46,000 suppliers to plant passive RFID chips in each individual product or case (Brito, 2004). Interestingly, the UPC standard for barcodes was set in 1973, but it did not take off until Walmart mandated the barcodes from its suppliers in 1984 (Brito, 2004).

Government action

Existing property rights and common law privacy torts offer some protection against privacy violations. For instance, RFID readers will not be allowed into homes without people's consent and human implantation of RFID tags would be completely voluntary. Past Supreme Court cases have generally agreed that radio frequency tracking is allowed without a warrant,

unless it violates a constitutionally protected area, such as the home (Brito, 2004). As long as RFID systems are used in public spaces—stores, libraries, etc., they do not violate the Fourth Amendment. The undesired activities that might be aided by RFID systems are already against the law, but the fear is that circumventing the law will be much easier and less obvious with RFID than with other systems.

The Federal Trade Commission (FTC) held a June 2004 public workshop to discuss policies to protect consumers from violations of privacy enabled by RFID (http://www.ftc.gov/bcp/workshops/rfid/).

Proposed state legislation

In 2003, the Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN) proposed a federal 'RFID Right to Know Act', which calls for mandatory labeling of all products containing RFID tags (http://www.nocards.org/rfid/rfidbill.shtml). Their proposal has reached the ears of some state legislators. A few states have proposed bills to regulate RFID:

Missouri	Retailers must include a label indicating RFID-tagged products
Utah	Retailers must include a label indicating RFID-tagged products Manufacturers and retailers must alert retailers of tags and teach them how to deactivate them
California	Prohibits item-level tagging except at the time of purchase or rent transaction

Source: (Brito, 2004).

Anti-legislation counterattack

Some naysayers think that the concerns about RFID are overhyped and that new regulation is not needed, or at least not in the near future. They fear that laws would restrict the technology and hinder technologically useful experimentation. Jim Harper of the Competitive Enterprise Institute argues that social forces such as economic incentives and consumer preferences will constrain RFID better than government regulation would. He supports waiting until fears are realized before intervening—a laissez faire over a precautionary approach. He also asserts that RFID tagging and reading is an imprecise and error-prone technology. However, his argument is not as credible given that technology can change so rapidly and move beyond passive tags (Harper, 2004). Some have confidence that retailers would not use RFID to the extent that it makes its customers uncomfortable, or that consumers will retaliate with blocking devices (e.g. signing up for the 'Do Not Call' telemarketing list).

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GPS

Spencer L. Lewis and Christine Ng

Introduction

GPS's ability to provide both precision location and velocity data in real-time combined has drastically changed activities ranging from warfare, earthquake prediction, and highway navigation. This memo describes the history of space-based radio navigation and GPS, examines policy issues, and discusses GPS competitors and growth potential.

History

Humans have looked towards the heavens for centuries to locate themselves on Earth. In the 1950s and 1960s, navigation by sun, moon and stars came to be supplemented by satellites. Managed by the US Navy, TRANSIT was a system of six satellites that allowed users to determine their position on the Earth's surface to an accuracy of 500 to 25 meters.[21] The TIMATION program used satellites with extremely precise atomic clocks that could then send time-relevant information to the Earth's surface.[22] From these two projects evolved the GPS NAVSTAR system which combined the passive range-finding techniques of the TRANSIT system with the precision timing of TIMATION. In summary, GPS allows a user to locate their position on the Earth by measuring the receiver's distance between three satellites. Since each satellite's distance from the receiver is calculated using information on the satellite's position and the time required for a signal to travel between the satellite and receiver, accurate time calculation is critical. Using a fourth satellite allows the receiver to eliminate this time offset from the calculation. The GPS system is usually decomposed into Control, Space, and User segments. The space segments consists of 24 NAVSTAR with additional spare on-orbit satellites in six orbital planes at an altitude of approximately 20200 km.[23] The control segment consists of five ground stations located in Hawaii, Kwajalein, Diego Garcia, Ascension Island, and Colorado Springs, Colorado that calibrate each GPS satellite and update software. The user segment consists of GPS receivers used for navigation and timing.

Security Concerns

GPS was originally created as a military system designed to aid in Naval and nuclear bomber navigation. Civilian access to GPS has increased steadily over the years, and security concerns have typically been dealt with on an *ad hoc* basis rather than by denying access to GPS or by degrading capabilities. When KAL 007 was shot down by Soviet fighter aircraft when it accidentally crossed into Soviet airspac, President Ronald Reagan opened the GPS system to civilian use. In May 2000, President Clinton authorized deactivation of GPS selective availability and allowed civilian access to military level GPS capability.[24] In effect, little can be done to limit an enemy's ability to use GPS short of turning the system off in the continental US and Europe and other areas served by Wide-Area Differential GPS networks. The US military has accepted civilian access to GPS because of its reliance on civilian GPS receivers. During the first Gulf War, the US military purchased massive numbers of civilian GPS receivers and turned off selective availability.

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[21] http://www.globalsecurity.org/space/systems/transit.htm

[22] http://www.globalsecurity.org/space/systems/timation.htm

[23] Pace, S. et al. (1995) Global Position System – Assessing National Policies. RAND MR-614-OSTP, p. 218.

[24] 'Improving the Civilian Global Communications System', May 1, 2000. http://www.ostp.gov/html/0053_4.html

Economic Concerns

GPS is recognized as a rapidly growing field that is projected to reach $22 billion in yearly sales by 2008.[25] GPS III satellites are under development, with explicit intent to address the concerns of civilian users.[26] EU concerns over US military control over GPS have spurred investment in the Galileo system as an alternative to GPS. The commercial appeal of Galileo may be reduced by its complex architecture, fee-based services, and the first mover advantage of GPS.[27] The Russian GLONASS system is still operational, but is limited by funding and technical problems. The civilian sector has been creating new applications for GPS at an ever increasing rate. Such high rates of innovation have been lessening the importance of military security concerns and encouraging lessening of government controls upon the network. Such advances are shown in Figure 1 and 2 below.

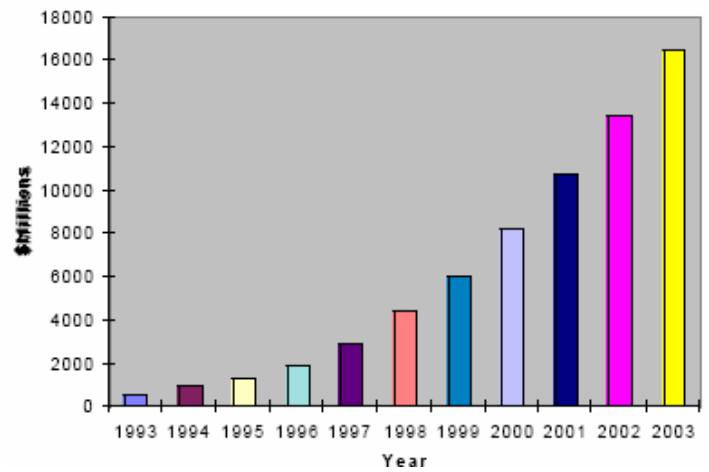

Figure 1. Worldwide GPS Sales from 1993 to 2003.[28]

[25] 'Global Market to Top $22 Billion' GPS World – GPS Inside, February 2004. http://www.gpsworld.com/gpsworld/article/articleDetail.jsp?id=86843

[26] Lazar, S. (2002) 'Modernization and the Move to GPS III'. Crosslink – The Aerospace Corporation Magazine of Advances in Aerospace Technology, Summer 2002. http://www.aero.org/publications/crosslink/summer2002/07.html

[27] Galileo Industries – Galileo Fact Sheet. http://www.galileo-industries.net/galileo/galileo.nsf/DocID/E05D16A511E69D1BC1256F0E00329116/$file/factsheet_final_engl_Allgemein.pdf

[28] GPS Market Projections & Trends in the Newest Global Information Utility, p. 22 http://www.technology.gov/space/library/reports/1998-09-gps.pdf

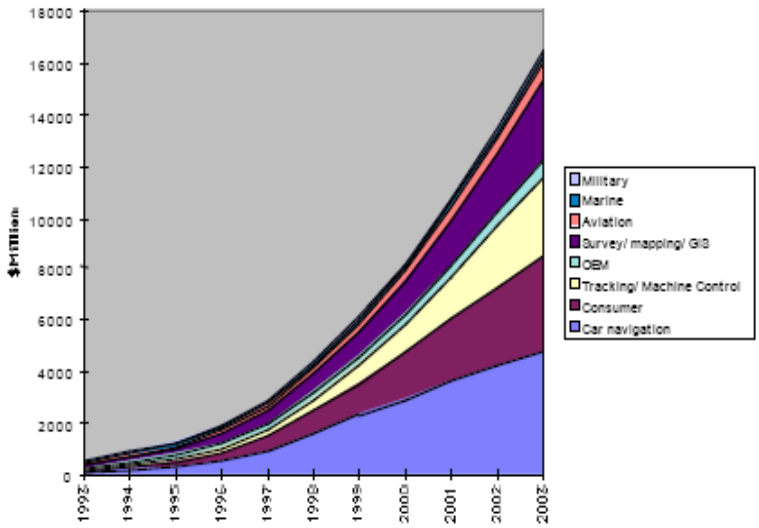

Figure 2. Worldwide GPS Projections by Market Segment.[29]

GPS, Cellular Phones, and Privacy Concerns

The FCC Enhanced-911 (E911) mandate states that by October 2001 cell phone carriers should have the ability to track 911 calls to within 100 meters to allow emergency responders to locate callers, with locational ability to be installed into all phones by 2006. This mandate was favored by industry since the technology already exists and the mandate also provides an 'economic bootstrap' for fledging location-based services. This technology raises privacy concerns. Pertaining literature includes Jeffrey Rosen's *The Unwanted Gaze* that surveyed the individual's lack of privacy in the digital age and David Brin's *The Transparent Society* which discussed the topic of ubiquitous surveillance and questions pertaining to who will have access to that information. In April 2002, the European Law Enforcement Organization, an association of EU police forces, created a secret list of data that it wanted all Europe's ISPs and telecommunications companies to retain in perpetuity. This list included information such as web sites visited, phone calls made, usernames, and passwords.[30]

[29] Ibid, p.24.

[30] The contents of the list were leaked to the web page cryptome.org

Who lives at this address?

Why data processing costs may overwhelm the benefits of ubiquitous sensors

Jon Lindsay

IP addressing, RFIDs, geographical coordinates, social security numbers, phone numbers, and nearly any other addressing scheme all involve a relationship between a standardized piece of information and some real place, person, or thing in the real world. Maintaining this referential relationship takes a lot of engineering and institutional work, and many things can go wrong. Here are just a few of them:

- IP address conflicts (resulting from different machines on the same network sharing the same address) can cause service denials or degradation; furthermore, there are not enough IP addresses even available to meet demand in the immediate future.
- Likewise, a person's social security number is hardly unique as the government has been forced to recycle them for some time, and some people may even have been assigned multiple numbers.
- Geographical coordinates come in a vast number of formats from UTM to MGRS to Digital Degrees to Degrees Minutes and Seconds, a problem compounded by the existence of multiple datums (the point where the mathematical ellipsoid modeling the earth contacts the real earth) which can result in 'the same' coordinates being off by miles.
- RFIDs track devices, products, and people, but there is not yet a 'universal product code' for all RFIDs, nor is it clear how one could possible encode all the contextual information that future uses may require.
- Connecting a simple telephone number to the intended person is contingent on a complex system of technology, public regulators, local exchanges, and long distance companies, any of which can fail, including the simple case when that person forgets to pay a phone bill or leave a forwarding number; with cellular phone numbers the 'area code' now often doesn't refer to any area at all.

With ubiquitous, embedded technology on the horizon, enthusiasts foresee a complete virtual map of the real world with boundless business and social possibilities, while pessimists fear that their every move will leave digital signatures to be exploited by corporations and nefarious government agencies. However, both of these extreme positions tend to downplay the vast information-processing load that this technology will generate. While there will indeed be ever more digital signatures than before, determining just who or what made them, and determining which signatures were made by the same someone or something, will be a daunting challenge. It's not simply a matter of actors behaving strategically to spoof or manipulate a sensor (although that is also a source of reference failure); even sensors that collect good data will likely do so in formats that are not perfectly congruent with other sensors collecting good but different data about the 'same' object, or that legacy data will omit important contextual markers that future uses of that data will require.

This is the classic 'different views of the same elephant' problem massively expanded and complicated for the digital age. Different addressing schemes, encoding standards, and database keys, all developed to solve some particular problem and thus making slightly

different assumptions in slightly different contexts, will give rise to all sorts of referential ambiguities. Solving these failures of reference with technical translations or institutional arrangements takes time and effort, during which time even new uses are invented and new problems solved with new sensors or encodings. The overall result of this conservation of uncertainty is hardly lifting the fog of war, but rather shifting the fog:[31] while we may sense ever more of the world, we may find ourselves ever more entangled in data deconfliction, reconcilitation, and quality control on a grand scale.

A military example may be helpful here. Military targeting during the Cold War grew out of institutions developed in the WWII strategic bombing community. The kinds of targets of strategic interest were those that would be struck by bombers and nuclear missiles: large fixed facilities like factories, military bases, and population centers. These facilities were tracked in intelligence databases, which assigned a unique primary key to each facility called a basic encyclopedia (BE) number. This number, since it referred to a fixed facility, could be used to target not just bombs, but surveillance satellites as well, and thus became the primary key for a lot of intelligence analysis and collection systems. Perennial analytical problems included identifying facilities, determining whether one facility was actually two collocated facilities (and thus warranting separate BE numbers), assessing whether a facility still had the same function or had changed completely. Maintaining data integrity for all the different distributed players who depended on different aspects of systems using BE numbers became an expensive, time-consuming, and rather unglamorous process. In this context, the bombing of the Chinese Embassy in Belgrade can be thought of as an addressing failure: aircrew delivered their bombs to the 'right' BE number, but that number did not refer to what it 'should' have, owing to analytical quality control deficiencies. New kinds of problems emerged with the BE number system after the Cold War, when the targeting focus shifted to mobile targets like SCUD and SAM batteries: did the BE number refer to a target or to a deployment site? The line between tactical close air support, which uses a different target tracking standard, and strategic bombing began to blur in the 1990s, and a lot of creative patches in both technology and organizational doctrine were required to retrofit BE numbers to deal with new requirements. This problem is now amplified even more, now that the problem is targeting individual terrorists rather than fixed facilities. What kind of primary key should a person have? An event? An organization? What happens when databases fill up with multiple traces of the 'same' target under different primary keys, or phantom targets that exist only in databases but not in the real world? Greater sophistication of sensors and targeting objectives leads to greater data management problems.

Economists emphasize that truth and transparency are preconditions for the efficient operation of markets; however, these conditions are rarely met, giving rise to various kinds of market failure (as well as second-order failures of institutional corrections). The addressing problem—the fact that informational reference can and often does fail—is one reason why there is no perfect information in real world markets for any kind of good. Any map is not the territory, and making a more perfect map is always costly. If we think of the future of ubiquitous embedded sensors in terms of a market for knowledge, then massive information imperfections caused by addressing ambiguities and incompatibilities will make this market rather inefficient. These inefficiencies will both disappoint enthusiastic futurists and provide some refuge for pessimistic libertarians (because Big Brother's brain will become a poor interface between eyes and arm).

We need to develop a more systematic understanding of the addressing problem: we need to understand the ways in which reference fails in complex socio-technical systems and how individuals and organizations work to fix it. It is important to recognize that all information is realized in some physical pattern: artifacts, acoustic and electrical waves, neurons, etc. This physical pattern stands in some relationship to some thing or state of affairs. Often the relationship is very complicated, depending on both the standardized physical form of information artifacts as well as the understanding of actors manipulating them. This means that there are lots of different opportunities for reference to go bad. Right now we have no idea what sorts of devices, uses, and standards will be developed. We can probably be sure

[31] ADM Bill Owens actually wrote a book called 'Lifting the Fog of War' about how ubiquitous sensors and information technology on the battlefield would permanently reduce uncertainty for 'network centric' forces.

however, that even if standards are completely open (which is unlikely), they will not be developed in an environment of perfect coordination. The very physicality of information, and the fact that it stands in a complicated physical relationship to its reference, prevents just this sort of perfect coordination.

This paper merely points in the direction of these problems. We can probably get a lot more specific about just what they are. There are both policy and engineering implications to this line of inquiry: for starters, are coordination costs a linear or exponential function of sensor inputs? If it's the latter, something's gotta give…

Four Characteristics of New Media and their Implications for Research

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In the first edition of the *Handbook of New Media* (Lievrouw and Livingstone, 2002), and in the forthcoming updated student edition, Sonia Livingstone and I argue that new media—their infrastructures, uses and contexts—are socially shaped in characteristic ways, and have particular consequences, that distinguish the contemporary information/media environment from the mass media 'processes and effects' of an earlier era. With regard to social shaping, the development of new media is *recombinant*, that is, they are the product of the 'continuous hybridization of both existing technologies and innovations in interconnected technical and institutional networks' (p. 8). This ongoing relationship between human action and available technical and cultural resources gives contemporary information and communication technologies their persistent sense of 'newness' or renewal, and sets the stage for unanticipated modes of adoption and use (reinvention, reconfiguration, adaptation, remediation, hacking, sabotage, and so on).

New media are also shaped by—and themselves shape—what we call the *network metaphor*, the widely-held view that point-to-point networks are:

> ... the archetypal form of contemporary social and technical organization [which] denotes a broad, multiplex interconnection in which many points or 'nodes' (persons, groups, machines, collections of information, organizations, or other entities), are embedded ... any node can be either a sender or a receiver of messages—or both.
>
> (Lievrouw and Livingstone, 2002: p. 8)

Networks thus depart from the hierarchical, one-way distribution configurations typically associated with mass society, mass production and consumption, and mass media.

The consequences of new media are also distinctive. Of course new media have had innumerable consequences—some idiosyncratic, some sweeping—in almost every arena of social, political, economic and cultural life. But we single out two in particular. The first is their real or perceived *ubiquity*, the sense that they 'affect everyone in the societies where they are employed', even if not everyone in those societies actually uses them (Lievrouw and Livingstone, 2002: p. 8). The expectation of ubiquity is largely the impetus behind the wave of empirical work and commentary over the last decade about the existence and implications of various 'digital divides', for example. The desire for ubiquitous, interoperable infrastructures with common or 'translatable' standards has also encouraged the development and diffusion of mobile technologies, such as mobile telephony and wireless Internet access.

The second noteworthy consequence is the sense of *interactivity* associated with newer information and communication technologies, that is, the selectivity and reach that new media afford users in the 'choices of information sources and interactions with other people' (Lievrouw and Livingstone, 2002: p. 9). The immediacy, responsiveness, and social presence of communication via new media channels constitute a qualitatively and substantively different experience than what was possible via mass media channels (even those that have occasionally been characterized as 'interactive', such as remote control television).

These four distinctive characteristics of new media—recombination, the network metaphor, ubiquity, and interactivity—are complex phenomena and space here is limited. However, I would like to present an example in which all four aspects come into play and raise a variety

of possible research questions. I then propose that the kinds of research questions associated with mediation today require a different methodological approach than what is typical in most mass media and 'Internet' research.

Imagine that (for whatever reasons) you wish to read something that you'd prefer that others not know you are reading. To some, such a situation automatically brings certain kinds of extreme, indecent or illicit content to mind, such as pornography, racist propaganda, or directions for mixing up poison gas. But it could also be the case that you are an abused spouse and want to read about gender and power; or you are a questioning teenager in a small, conservative town who wants to read a GLBT newspaper from a nearby city, or a dissatisfied office worker who wants to learn what's involved in unionization. Or, you are a prominent university professor and intellectual who is a passionate reader of Jackie Collins novels. For whatever your reasons, what would you have to do to keep knowledge about what you read to yourself?

You could travel to a neighborhood where you don't usually shop, on a crowded city bus or metro (fare paid in cash) so your personal vehicle isn't seen in the vicinity. You might stop in to a bookstore you've never visited, pay for the book or newspaper with cash, and carry it out in a plain bag. If it's a pleasant day, you might take your purchase to a nearby public park to read it there, assuming that none of your acquaintances are likely to stroll by and see what you're reading, and that people who do see you won't notice or remember you or your book later. Or, you might visit a public library to find the material, taking care that the library is one you generally don't visit, that you don't borrow anything (and thus leave a lending record), and that if you ask the librarian for assistance, that he will not notice your request in particular, or remember you later. It might be risky to take the material home or to work, so you must either read the whole thing then and there and leave it, or find someplace to keep it securely until you are able to finish reading. Once you have read it, you must avoid referring to the material (knowledgeably, at least) in your interactions with others.

When the scenario shifts to the online/mediated world, the possibility of unobserved and unevaluated reading or inquiry is seriously compromised, as legal scholar Julie Cohen persuasively argues (Cohen, 1995, 2004). In the case of reading online, all four aspects of 'new mediation' come into play. Detailed information about individuals and what they read can be captured and collected from online purchases, visits to web sites, mobile phone records, subscription and credit databases, clickstream data, and so on; the collection and retention process is recombined with new methods of filtering, comparing, and classifying one's reading habits with others'. Interested observers (e.g., commercial interests, service providers, government, law enforcement) can situate and interpret one's interests and habits in the context of a unique pattern of networked relations among people, books, purchases, geographic locations, other media uses, contents, and so on. The ubiquity and interconnectedness of the channels used to store, distribute and retrieve the information radically extend the scale and scope of what can be collected and evaluated, and by whom. Policies or rules for when, why and how systems retain the information are largely *ad hoc* (Blanchette and Johnson, 2002). The contextualized, interpreted information can be delivered on demand, in rich, specifically targeted detail, in a convenient format and linked to a variety of related materials. One's subsequent queries and reading may be influenced by services that retain information about what has been seen and how much time was spent looking at it, and that recommend 'more like this'. To the extent that the reader is aware that her choices and interests are being observed, collected and analyzed, she may (perhaps without thinking about it) begin to limit her searches and reading to materials that would be unobjectionable, or at least unremarkable, to others (Gandy, 1993).

Obviously, few of us would ever want or need to go to extreme lengths to obscure what we read from others' observation. But the point of the exercise is that it raises a variety of possible research questions related to new media. What constitutes 'reading', especially in intensely mediated and monitored communication and information environments? How is it shaped by social and material conditions over time and in different places? What is its relationship to literacy or speech, to intellectual freedom and inquiry, to agency and action, to social and political participation (Post, 2000; Meiklejohn, 1948; Cohen, 1995; Froomkin, 1999)? Are secrecy, anonymity, privilege, privacy, transparency or reciprocity necessary or

sufficient conditions to insure interaction and inquiry in mediated settings? How do people make, perceive, recognize, engage in, change, or document communication and information environments, whether online or offline, as 'places'? Can people learn to recognize these places or opportunities for interaction and inquiry for what they are, and learn to occupy and use them for their own or shared purposes? Can places that are conducive to open inquiry and interaction be created as needed given certain social conditions or technological networks? Who might have an interest in preventing or constraining such places, and are those interests legitimate? Can situations with the right combination of resources and conditions for interaction and inquiry be made legible, understandable, and usable to actors in them?

The hypothetical reading situation illustrates that contemporary mediated and monitored social contexts differ in important ways from contexts dominated by the production–delivery–consumption model of mass media. To study mediation today, research designs and methods must suit the recombinant, networked, ubiquitous, and interactive modes of communication and information sharing, and the ensembles of technology, practices, and social formations, that comprise new media.

What would such designs and methods involve? My principal suggestion is that, given the profoundly relational nature of the contemporary media and information environment (including interpersonal interaction, information retrieval, and technical infrastructure), network analytic approaches should be a much more central part of new media research, alongside the surveys and fieldwork that currently dominate 'Internet studies'. The family of network analytic methods includes social network analysis (Wellman and Berkowitz, 1988), bibliometric and scientometric methods (Borgman and Furner, 2002; Leydesdorff, 2001), web metrics (Huberman, 2001), and actor–network theory (Law and Hassard, 1999), among others. Although different units of analysis (e.g., individuals; organizations or groups; published documents; web sites and traffic; servers or other network nodes) are involved in each case, what all the techniques share is a focus on the *relations* among the units, and the nature, patterns, strength, dynamics and meaning of those relations, rather than measuring and tallying the traits of the units themselves as predictors or causes of other phenomena (Emirbayer and Goodwin, 1994). Regardless of the type of data being analyzed, whether qualitative or quantitative, network analysis techniques apply the same sorts of clustering procedures and reasoning. The point of the analysis is to describe and understand complex social and technological interrelationships and how they develop over time. This relational focus is well suited to the recombinant, networked, ubiquitous, and interactive nature of new media technologies, contexts, and uses.

Generally speaking, however, network analysis in most of its forms is considered difficult or arcane, and is not widely taught outside of a few specialized courses. Very few accessible texts on network techniques are available, and to date no text brings together and compares in a single volume the techniques used in different disciplines or research applications. Even those researchers who do use network analytic methods tend to specialize according to discipline or training (social networks in sociology, communication, and organization studies; diffusion and innovation networks in economics and communication; bibliometrics in information science; web metrics in computer science; actor–network techniques in science and technology studies; and so on). Moreover, they rarely combine network analysis with other methods to triangulate or enrich their findings. This segregated approach has obscured the possible articulations, layerings, or mappings among different types of networks and relations and prevented analysts from studying the real complexity of communication and information 'environments' as coherent and meaningful to the people who create and engage in them. Therefore, I would propose a more cross-disciplinary or 'network of networks' approach to the social–scientific study of new media, with network analysis as a key methodological component.

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Engineering Social Change: The Umhlango Case

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Pondering the propedia of the Encyclopedia Britannica as one does, for 1977 and 1994, the latest available to me, I was struck with the similarity of design with the Dewey or Universal Decimal Classification Systems. It occurred to me that mapping the two of them, using a notation I won't explain here, would give us a resource of knowledge organisation which could be useful. Surely someone had done this?

Scuttling off to google gave me 6000 or so hits, which in a less expensive environment I may check further, but the first twenty or so didn't give rise to a ready answer. Posting on a couple of lists produced some replies but it does appear there isn't a ready made.

This gives rise to an issue in research method which seems to have not adjusted to the technology: the nature of the scholarly apparatus.

Earlier I had asked about ten of the people I work with, including professors, what they understood by the term. They had never heard of it. On another occasion I asked another ten, but who I knew were from a discipline different from the first ten, and they all knew.

This struck me as surprising, that a concept so generic doesn't have a name.

I then went to the library catalogue to see what existed on discussing the scholarly apparatus and found, to my surprise, nothing.

I could have used the term in the Encyclopedia Britannica where I would have found nothing, indeed so much nothing that scholarship has only monetary aid (1977). I could have begun a more thorough search, but I think I have enough.

We know we have a number of standards for constructing a reference in either an endnote or a bibliography and although there is an ISO it is generally not adopted and others are preferred. We know a citation, a reference and a bibliography, we know to teach students about proper referencing and constructing bibliographies and the evil of plagiarism. We have even made some attempt at working out how to fit the idea of a url into the AACR2 (Anglo American cataloguing rules).

We know we have Dublin Core and we know we have the concept of a subject field.

And at this point knowledge seems to break down?

We know we could pipe Dewey into the subject field, or UDC, or any other notation but we don't seem to do it. We know we have the UKAT (United Kingdom Archive Thesaurus) project and the HILT (High Level Thesaurus) project. Please note that in this note I am not going to make use of the scholarly apparatus as I don't at present have access to all my resources, and in any event to use what I am thinking about in the thinking about of it would be rather self defeating.

We also know we have (for me) more than twenty years of work in information retrieval, autonomy, ontologies, and the reports of TREC and yet doing a literature search remains little different from a lot longer than twenty years ago, unless there is something I don't know which everyone else knows, and I am the last one of earth to learn it?

We know we can clump library catalogues, and if you search on the Royal Historical Society (RHS) bibliography it will include a COPAC point which means you can check availability. We know that if we are a reader of the British Library we have access to (and here we run out of recognised names again) … shall be call them bibliographic databases, abstracting and indexing services, LISA, (Library and Information Science Abstracts) for example. We even know about the web of science, as it is currently known.

We know we have character strings and we can grep. We know about inverted files.

We also know about the expenditure of JISC (the joint information systems committee) of the Higher Education Funding Council and we know about SOSIG and likewise things.

But when we want to find out what is known about something, we haven't made a lot of progress?

It is many years ago that ERIC first used a controlled vocabulary with a taxonomy for the domain of education so that searching on a term produced the number of postings and the higher and lower levels of the hierarchy with the numbers of postings. That was a considerable step forward, in my opinion, but it has not been widely taken up. The UKAT project went ahead with building its own category list despite the existence of the UN Macrothesaurus. The electronic governance interoperability framework produced the government metadata framework which begat the central government category list while local government required the local government category list, and as at least one project pointed out, all these are concerned with the point of view of the producers of the scholarly apparatus, not the citizens, clients, customers, consumers, comrades or victims of these artefacts.

Is my point becoming clear?

This is information and information systems design as I understood it more than thirty years ago, a political process in which the organisation of documents is structured but structured in such a way that in order to understand the structure you have to be complicit in an adoption of a structure in society.

The Internet has changed the political economy of production, distribution, exchange and consumption of documents. This I have called elsewhere infopolecon, which remains a useful search term provided you know it.

But we have library catalogues, LISA and ERIC, google, and SOSIG.

February 2005 was declared lesbian, gay, bisexual, transgendered history month and supported by the Department for Education and Skills along with the Mayor of London. This seemed a chance to do a small piece of field work and see how all these things stack up. I wrote a paper before hand which was published in *Information and Social Change* (another good search term once you know it) which seemed to me to summarise.

During the month I then undertook a series of small comparative studies starting from the catalogue of the British Library and google, searching first in the BL catalogue on the term homosexuality then following the leads I was given.

These cases I have written up and will publish elsewhere. All I want to point to at the moment is the terms I found myself developing, the stories I found myself telling. Theocritus was one of the first. That makes a good search term. Plato doesn't. But Phaedrus does. Symposium doesn't. Machiavelli doesn't but Machiavelli and gay or Vettori does, these latter in google but not in the British Library. The Vettori link I picked up by complete accident reading Wells New Machiavelli where he refers to a scandalous letter. The qadash makes a good search term, as does the ghazal and these show the wide spread of an idea. The wages of the dog of the temple I found most puzzling in the King James Version of the Bible, Deuteronomy 23.18. Barnfield makes a good search term, but Spenser and Shakespeare don't.

There is the potential to do much more in this area, my conclusion is simple: much that passes as knowledge is the hidden codes built up over the whole of human history for men to organise being able to shag one another without those others knowing about it.

So there will be a danger in making these codes explicit.

But that is a risk we have to take, for in a time where diversity, sustainable development, are on agendas we have a chance to make a difference that makes a difference, and we have a purpose for examining how the old technologies of the organisation of knowledge and the new ones allow people to make new knowledge and in the process change the old ones. We have a chance for people to tell their own stories and in the process change those.

What can we say about the contribution of previously existing research methods to our meat, whether we call it lgbtq (which makes a new and rather useful search term once you know it, though how it might be pronounced I haven't worked out yet), sustainable development, diversity, or another concept which hasn't yet been engendered (if that isn't too dreadful an exercise in natural selection)?

That has to take us I think to the funding streams which keep the academic and technological show on the road. The thought leads me to the argument that scholarship has been too much about civil mercenaries and too little about civic missionaries.

We know the concept of the scholarly apparatus and we know how to build this apparatus into a database. We know that words have meanings based on their use and that use includes irony. Words my mean their opposite. We know that organising knowledge into a university or an encyclopedia (for in Latin and Greek the words mean similar) allows or insists that contradiction sets up dynamics for social change.

I'm writing this in Umhlanga, where I have just found that Umhlango means in Zulu a social gathering or community gathering where it is permissible for anyone to say anything they consider material to the matter of business in hand.

It is rather remarkable that I had never had this connection made before. South Africa, and in particular perhaps the Universities, are going through a social change in which in post apartheid they are having to unpick the structure of knowledge and deal with a new pedagogy and a new research for sustainable communities. The technology of libraries, databases, google, the Internet are co-existing, yet information systems design is tucked away within business administration, computer science, information studies, and the planning and management of communities seems a long way away from what is propounded in the Higher Education Funding Council for England action plan on sustainable development and higher education. Though some have noticed that the World Summit on Sustainable Development and the World Summit on the Information Society (WSSD Johannesburg 2002, WSIS Geneva 2003 and Tunis 2005) have taken place, that governments have signed up to their action plans, very little seems to be happening on the ground.

We need to turn to the idea of the predictive category and its relation to the organisation of knowledge.

I think we need to invoke the paradox of Jeremiah, for engineering social change is about making it happen. Deciding what is to happen and attempting to happen it seems to me to require more attention be paid to organisational forms.

We know quite a lot about the form the governance of the development of the Internet has taken and we know something of how to categorise the components of which we consider it to exist. What I think we haven't paid enough attention to is the organisational forms of professionalism with which it must needs be concerned. This flows through into the construction of curriculum, which is validated by professional societies, at least in Britain.

In order to engineer social change it seems to me we have a very simple task, re-engineering the categories. Then developing methods for linking categories together, what I will call

integrated indicators. We need methods of visualising these, so opening them to communication. This all means we need to develop architectures of metadata and the standards of metadata interoperability, and these need to be international public goods. All this is in the action plan of the WSIS. But meanwhile the stories I have illustrated continue.

I asked three Zulus in turn what Umhlanga means, and each of them said that it was the name of the place. So I can't tell whether the story about the community gathering in which anything which pertains to the business may be said might be true. The day I was finishing this note, the local paper had a story about two white gay men, one of whose father I had known, bringing up two black girls they had adopted. This would not have been possible, neither the case nor the reporting of it, until recently. Social change has occurred. But it could not have been predicted and it was not engineered. Events happen. They make evidence. Evidence is marshalled into cases. This is reported and the report catalogued. Records are classified and associations made. Relations are built. These all become social knowledge and in the process change happens. Some of us are clear about the change we want to happen though we don't often find others to agree with us. This includes reports on research and papers on research methods.

Personal Identification and Identity Management in New Modes of E-Government

(ESRC/E-Society project, 1 February 2005–31 January 2007)

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General focus of this research project

This research will gather data on varying information and communication technologies (ICTs) that are used to collect and compile personal data for identity management purposes in e-government relationships with citizens. The project will seek evidence on the managerial, governmental and democratic implications of these new digital means of identity construction, personal identification and authentication, so as to provide governments and citizens with deeper understanding of shifting information relationships between them. This research will also seek new conceptual understanding of the nature of 'identity', 'identity management' and 'authentication' in e-government and seek to place this conceptual development into theoretical contexts that enable clarification of the changing roles of administration and the citizen.

The research team in particular sees overlapping issues for further discussion at the MIT–OII workshop in the following domains:

- **The nature and management of e-identity in varying online environments**
- **Trust and loss of confidence in online environments**
- **Rules for surveillance in cyberspace**

Technological access points to e-government application areas

The technologies that we will address in this project are deeply implicated in attempts to change institutionalised practices in the relationships between citizens and governmental agencies. There are eight principal technologies that we will examine in this research. We consider these technologies as primary technological access points to e-government application areas where design and implementation choices towards identification, authentication and identity management have already been made. The case study examples below are offered for illustration only:

(i) **Fixed telephone service:** e.g. citizen health related enquiries and treatment on 'NHS-Direct';

(ii) and (iii) **Mobile telephone based services** (i.e. both text based and location based services): e.g. checking the progress of a University Admissions application (ii) and receiving personalised location advice for tourism (iii);

(iv) **Internet Portal:** e.g. Government Gateway: transacting with government over the Internet, such as submitting a tax return or by buying a TV licence;

(v) **CCTV:** using camera technology to identify 'secondary' data on the citizen e.g. car identification within the London Congestion Charging scheme;

(vi) **Biometrics:** e.g. authenticating the identity of airline travelers through iris scanning such as is currently occurring at 10 UK airports;

(vii) **Multifunction smartcard:** e.g. affording the citizen access to a range of e-government services through smart card identifiers, a good example of which is SmartCities Card in the city of Southampton;

(viii) **Electronic tagging technology:** e.g. allowing for 'automated' data capture on the movement of particular citizen groups such as is done under the Intensive Supervision and Surveillance Programme for young offenders in the city of Leicester.

This is a rapidly developing field both technologically and in policy application and, therefore, the research team will construct a sample of case studies during the first period of this research. Each of the selected case studies will be based upon one of the technological access points that we set out above.

Analytical focus

The theoretical and empirical cores of this research project are centred upon relationships to and from varying governmental settings and the citizen. The tools of analysis that derive from the theoretical framework that will be employed will focus the research upon the juxtaposition in identity management of potentially revolutionary technologies and the information flows relating to personal identity that they enable, on the one hand, and the evolutionary institutions of government and citizenship as the setting within which the technologies are employed, on the other.

Main research questions in this project

- How are 'personal identity', 'identification' and 'identity management' being reconstructed conceptually in different policy fields against this backdrop of new ICT applications in e-government relationships?
- To what extent are complexities in the institutional settings of identity management creating and sustaining ambiguities in operational definitions of these core concepts? What are the barriers and enablers within complex institutional settings to the harmonisation of approaches to identity management?
- What are the managerial and governmental implications of new electronic ways of facilitating the construction of identity, personal identification and authentication in e-government relationships?
- What information resources are being made available to agencies involved in e-government delivery from new means of identification and authentication? How reliable are these information

resources given the capacity of citizens to fake personal information in some situations, for example?

- What implications do new information resources deriving from identity management systems have for citizens and citizenship? Do agencies delivering e-government need all the personal information they collect to deliver e-government objectives and can citizens be sure that personal data is not being used by agencies without their consent, or misused in some other way? How are 'service values' for e-government being balanced against security and public safety values?

- Can cross-government learning occur from design decisions and implementation choices on identification and identity management in particular institutional settings and their relationship with the citizen?

People living in the new media age: rethinking 'audiences' and 'users'

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The information and communication infrastructure of everyday life

In the first edition of the *Handbook of New Media* (Lievrouw and Livingstone, 2002), and in the forthcoming updated student edition, Leah Lievrouw and I argued against defining new media in terms of particular technical features, channels or content and, further, against both technological and social determinisms when accounting for change. Instead, we sought to integrate technological, social, political and economic factors, analysing information and communication technologies in their associated social contexts by drawing on the concept of infrastructure (Cf Star and Bowker, 2002; see also Livingstone, 2002, chapter 2). These communication and information infrastructures, we suggested, have three components: the *artefacts or devices* used to communicate or convey information (raising questions of design and development); the *activities and practices* in which people engage to communicate or share information (raising questions of cultural and social context); and the *social arrangements or organisational forms* that develop around those devices and practices (raising questions of institutional organisation, power and governance).

In this brief paper, I consider the implications of such a framework for the general public—the audiences and users, or citizens and consumers, of new media. Taking our lead from their everyday experiences, needs and hopes, what questions should research be asking—about design and development, about the contexts that shape uses, and about the social arrangements that enable, empower or undermine?

In the days of *mass* media, a related but different three part framework was widely endorsed, centring on the production, text and audience for mass communication processes. The resemblance to our proposed approach is unsurprising—each aspect remains crucial, and the dialogue among the different disciplinary specialisms developed to address each is part of what makes our interdisciplinary field so interesting. The differences are also important, however. The three terms are not only significantly broadened in our above definitions (deliberately so, so as to be open in their boundaries), but they are thereby more thoroughly 'socialised', recognising that artefacts, activities and arrangements are inherently culturally and historically conditioned.[32]

Most important, we do not specify *a priori* any set relationship among these three component processes. Where the mass communication tradition has spent decades struggling with and, latterly, unpicking, the assumption of linearity (that production produces texts which impact on audiences, following the sender-message-receiver model), new media research need make no such assumption—hence our dual stress on both social shaping and social consequences in the *Handbook of New Media*. Indeed, it is precisely the dynamic links and interdependencies among these component processes that should guide our analytic focus. Recognising that dynamic interrelations are far from infinitely flexible, however, our stress on

[32] As, of course, were production, text and audience—yet the curious effect of the administrative communications tradition especially was to detach these components from the context that constituted them.

the term *infrastructure* is intended to capture the ways in which these artefacts, activities and social arrangements (and the relations among them) become routine, established, institutionalised, variously fixed and so taken for granted in everyday life.

In what follows, I focus on just one of these three components, namely the significance of the shift from 'the audience' to 'activities and practices in which people engage'—such an apparent infelicity in terminology requires some explanation, after all.[33] And I focus mainly on the internet.

Rethinking audiences, users and the domestic nature of mediated communication

In the *Handbook of New Media*, and elsewhere (Lievrouw and Livingstone, 2002; Livingstone, 2003, 2004), we drew attention to a widespread uncertainty—analytic, empirical, even semantic—in thinking about the relation between technology and the activities of ordinary people in their daily lives. The difficulties for the field are illustrated by the persistent problem of how to characterise people in both a *singular* and *collective* manner with regard to their engagement with new media. During the dominance of mass communications, people were defined by the medium, the technology—they become readers, listeners, cinema-goers, viewers. Each term, supposedly, characterised the most significant way—assumed to be singular—in which people engaged with the medium.[34] This permitted a broadly pejorative view of the general public—defined by, even exploited by, certainly determined by, the technology of interest. In each of these terms, people appear as an aggregate of individuals.

Interestingly, the term that captured all these separate terms—*the audience*—did represent people as a collective, but as one which was also often negatively viewed—the mass audience, located within mass society, engaged with mass communications, inviting research questions that stressed its singularity (Livingstone, 2005).[35] What, social scientists asked over several decades, were the effects of mass media on the audience, what were the needs or gratifications obtained by the audience, how should the audience be planned for, targeted, regulated, and so forth.

Research on 'the audience' began to unravel at the end of the twentieth century. Audience researchers were already seeking different ways, different terms for understanding the processes by which television engaged with its audience—moving away from the language of effects or impacts, towards a conception of the active audience or the diffused, embedded audience (Abercrombie and Longhurst, 1998), moving away from the commercial construction of the audience towards a civic or cultural perspective on audiences (Livingstone, 2003). The audience was gradually, in some cases reluctantly, acknowledged to be less affected and vulnerable, more selective, diverse and plural, even perhaps culturally resistant, while also finding considerable popular pleasure in television.

But for new media we can begin by taking precisely these assumptions for granted. In so far as they engage with new media, we can start by assuming people are diverse, motivated, resistant, literate, and so forth. Similarly, mediated content and forms are now socially

[33] The purpose, however, is not restricted to understanding people's engagement with new media but also seeks to unpack the implications of this for artefacts/design and for social/institutional arrangements, since these are all linked. Where mass communications tended to ask first about production and texts, leaving audiences till last or, even, forgetting to research them—taking their responses for granted, or drawing merely on anecdote—in new media research we must beware of repeating the same mistakes.

[34] So, readers were informed, contributing to public opinion; listeners were more social, oriented to the national culture; cinema-goers were defined more by their social customs than their interest in film genres; television viewers were passive, uncritical, populist in their tastes.

[35] It has become increasingly apparent that new media require us to reconsider the longstanding dependence within media research on theories and phenomena of mass society, and many are turning to theories of post-industrial, late modern, or post-modern society to help understand the wider changes within which new media—and processes of mediation—must be analysed.

diversified (rather than directed primarily at the masses), channels are technologically convergent (rather than distinct systems), and mediated communication processes are interactive (many-to-many rather than one-to-many with separate producer and receiver roles). After all, 'new media and information technologies open up new, more active modes of engagement with media—*playing* computer games, *surfing* the Web, *searching* databases, *writing* and *responding* to email, *visiting* a chat room, *shopping* online, and so on' (Lievrouw and Livingstone, 2002).

The single term *audience* does not capture this diversity of activity. We cannot say, *the internet audience*, though some try. *Users* does not work either, though more try this. *Users* is too broad—it has little to do with information and communication, though hitherto it has sufficed for engaging with computers (people are also users of pens, batteries, washing powder, and there's nothing *new* in that). *Internet users* works only because it is entirely vague, neither excluding but neither pointing to anything specific about the way people engage with the internet—it's an empty term, homogenising within the category of users, contrasting them only with the diminishing category of nonusers. And unlike the mass audience of mass society, users are an aggregate of individuals, they have no collective status and hence, it seems, no collective power. So our problem remains in capturing what is specifically new, and specifically concerned with information and communication media.

What shall we say instead? *People* is as good a term as any, and better than some. It's not a trite suggestion: try putting *people* in place of *users* in social science writing about technology, and immediately their interests, concerns, knowledge and rights leap into focus (while it seems peculiar to ask about the civic potential of audiences, the rights of users or the creativity of consumers). It captures both their individuality and their collectivity, it is neutral about their abilities and interest but resolute in defence of their needs and rights. *People* privileges no one academic discipline, asserts no new jargon, takes their plurality and diversity for granted, and includes us, the observers, within the analysis. It works also in other languages (unlike audiences, users and consumers; Livingstone, 2005).

The diversity of new media activities and practices also challenges the familiar and long-dominant focus of mass communication research on the home and leisure, although belatedly questions have been asked about the relation between audiences (or media consumers) and publics (the role of media in citizenship participation) (Livingstone, 2005). For the most part, television audiences were kept—analytically, politically—within the domestic, the private sphere. Setting aside the various and important challenges to such a sequestration of audiences, now that we are turning to people's activities and practices in engaging with new media, such a starting point is evidently implausible.

New media span, or blur, key social boundaries—work/leisure, home/community, private/public, education/entertainment, commercial/civic, interpersonal/technologically mediated communication, personal/political, local/global, and many more. How we think about people's engagement with new media cannot, therefore, be bracketed off as 'only' important in the domestic or leisure realms. People are at the centre of new media practices, design and social arrangements across all spheres of society—as workers, students, entrepreneurs, information-seekers, parents, political activists, fun-seekers, criminals, even researchers. In using these more specific terms, we activate a rich seam of already-existing social scientific knowledge and understanding, and this too is important. And since no all-purpose collective term has yet emerged, despite the semantic need for one, it must be that no single term can suffice: the diverse ways in which diverse kinds of people engage with and through diverse forms of technological mediation provides our starting point, a very different one from the early days of mass communication research.

Towards a research agenda

Having sketched a framework of starting assumptions for thinking about the nature and significance of people's activities and practices in engaging with new media, what should the key questions be? How shall we take forward an agenda based not on how people engage

with particular technologies with particular features so much as one based on how people relate to each other, mediated by certain technologies? (Livingstone, 1998; Silverstone, in press).

The move from social versus technological determinisms to a focus on mediation, both social and technological, is necessitated by the move from mass media to new media and, more fundamentally, by the move from modernity to late modernity (Lievrouw and Livingstone, in press). So what's new here for people in their everyday lives? As Leah Lievrouw has outlined in her paper for this conference, we have identified four key characteristics of new media which elaborate the 'social shaping and social consequences' of the volume subtitle, these contrasting with the characteristics of traditional mass media.[36] These concerns focus attention on the *ubiquity* of information and communicative action; the *recombinant* modes of access, use and content; the dynamic, point-to-point *network* structures; and the potential for personal engagement and *interactivity* that people experience via new media. I shall conclude with some questions that follow from these key claims:

> (1) New media artefacts, activities and arrangements are recombinant in character, socially shaped by what already exists, what goes before. So, this invites a focus on people's creativity in moulding technological innovations to their needs and contexts, creativity being a little understood but key feature of everyday life. We struggle even to judge creativity when it occurs. The flip side is people's desire for predictability, familiarity, routine, an equally strong motivator. In the design of information and communication technologies and contents at present, neither issue is adequately addressed. Faced with the internet, people are erratically creative but mostly flummoxed. Many are becoming reassured by the predictability of branded environments online, and take up of expressive or non-normative opportunities is tentative or low, beyond a self-appointed elite subgroup. Responding to the new media environment demands new literacies, especially critical literacies, and also productive literacies. Literacy is a product of the interface between people, with their skills or otherwise, and mediations, with their codes and preferences. In balancing skills and design in the production of new media literacies, the question is one of interest—in whose interest is it that certain online opportunities are taken up over others? Whose responsibility is it that people engage with new media in their own interest? How do we balance the public interest against the commercial agenda? Could and should people's activities shape the emergence and diffusion of innovations in different or better ways?
>
> (2) New media artefacts, activities and arrangements are characterised by network relations, shaped by the broader social and political shifts in late modern society. So, as Castells (2002) has stressed, the key issue here is inclusion and exclusion. As we move from talk of the digital divide to that of digital inclusion, our key questions must be: what is the public good in being digitally included—taken for granted but empirically uncertain? Do new media introduce new forms of inclusion and exclusion, or do they merely repeat and reproduce familiar forms of social and economic exclusion? How can we move from the inspiring but small-scale example of best practice to using ICT to significantly ameliorate long-established social stratification? Given the continuous march of technological innovation in capitalist society, can we ever expect anything other than the persistent reproduction of inequality among the population? What are the implications of the growing importance of networks over traditional forms of social organisation (characterised by hierarchy, centre/periphery, insiders/outsiders) for

[36] With regard to social shaping, we suggest that the development of new media is recombinant, that is, they are the product of the 'continuous hybridization of both existing technologies and innovations in interconnected technical and institutional networks' (p. 8). New media are also shaped by—and themselves shape—what we call the network metaphor, which 'denotes a broad, multiplex interconnection in which many points or 'nodes' (persons, groups, machines, collections of information, organizations, or other entities, are embedded ... any node can be either a sender or a receiver or messages—or both' (p. 8), this contrasting with the hierarchical, one-way distribution configurations typically associated with mass society, mass production and consumption, and mass media. We suggest further that the consequences of new media are particularly distinctive in relation to their real or perceived ubiquity, the sense that they 'affect everyone in the societies where they are employed', even if not everyone in those societies actually uses them (p. 8). And in relation to the sense of interactivity associated with newer information and communication technologies, that is, the selectivity and reach that new media afford users in the 'choices of information sources and interactions with other people' (2002, p. 9).

normative processes of social identity, cohesion and regulation in new media environments and beyond? Where the audience was once over-homogeneous, provided with limited choice, does the new diversity on offer undermine people's striving for communality?

(3) New media artefacts, activities and arrangements are ubiquitous in their social consequences. Our point here is to stress the ubiquity of the social consequences regardless of whether or not individuals are 'users' or 'nonusers'. While some play a greater role than others in shaping the new media environment, all must live in it, though again the inequalities matter. And what of changing boundary between on and offline, or new and old, or mediated and face-to-face? What are the consequences of ubiquitous information and communication for traditional/alternative activities and arrangements? How are the latter *remediated*, and how is the resulting array of *opportunities* altered? Particularly, do ubiquitous information and communication enhance choice, furthering the rights agenda, enabling and empowering people? Or does *choice* serve other interests, confusing and undermining opportunities, enabling exploitation and disempowering people?

(4) New media artefacts, activities and arrangements are interactive, changing the relations between senders and receivers, producers and consumers. This is where creativity and community are meant to come together, in enhancing participation of all kinds—creative, personal, community and, especially, political—both mainstream and alternative. Despite much excitement and hyperbole, the evidence as yet is disappointing, both that the new media environment is opening up genuine and valuable new opportunities for enhanced participation and that people are taking these up in significant numbers. In my work with young people, there is more evidence that the young are interested, taking the first steps, but that the environment is not truly interactive—no-one, it seems, is listening when they 'have their say' (Livingstone et al., in press). Other than for peer-to-peer communication among known parties, interactivity seems more effective at present in terms of interacting with documents (in Sally McMillan's terms) than interacting with social institutions. And for the former, interacting with documents, to be effective, critical literacy (as noted before) is vital. So, how can participation of all kinds be enhanced or is the internet more like television than supposed—still crucially (in political and economic terms) a communication from one-to-many?

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New Approaches to Research on the Social Implications of Emerging Technologies

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1. Transdisciplinary Research and Studies as key-approach

Due to globalisation and to the growing complexity in the so-called information/communication/knowledge/network society, the analysis of the social implications of emerging technologies challenges traditional disciplinary approaches. We need to utilize the knowledge of different disciplines/fields/sciences in order to develop more comprehensive approaches. Simply said, social scientists and researchers from the humanities need to better understand technological processes and the logic of engineering as well as the functioning of technology itself. On the other hand, engineers and computer scientists are needed, who implement theoretical societal approaches as well as social scientific methodology into their work.

It is one of the foremost goals at the newly established ICT&S Center to enable dialogue across disciplinary boundaries in order to enhance inter- and transdisciplinary research in the future. But dialogue is not enough. We are convinced that genuine new theoretical and methodological approaches have to emerge out of cross-disciplinary research which leaves the original cooperating disciplines changed. Hence, an integrative, holistic and *new* scientific contemplation is needed.

Such demand for cross-disciplinary research in order to meet the challenges of identifying the social implications of emerging technologies is not new. 'Interdisciplinary' research is a widely shared buzzword in project proposals. We think the more radical concept of 'Transdisciplinary' has to be introduced into ICT research.

We suggest the term *trans*disciplinarity instead of *multi*disciplinarity. The concepts of *multi*disciplinarity and *inter*disciplinarity suggest a juxtaposition of different things (at least in the German language), a static combination of disciplines which remain more or less unchanged in terms of basic concepts and approaches. See, for example, the concept of *multiculturalism*. People from diverse ethical/cultural/religious backgrounds might be accepted in different cultures, but no new quality of commonness evolves. *Trans*national corporations, in contrary, revoke national boundaries and change the host society.

Transdisciplinary research can be characterized as *dialectical interplay*. In this context single disciplines dissolve into an entire new scientific field with *new* theoretical models, *new* methods, and therefore a *new* quality of problem solving is expected to emerge. Results of transdisciplinary research cannot be reduced to any single discipline anymore.

Transdisciplinarity does not only mean the convergence of academic and scientific disciplines, but also to move beyond the ivory tower and to embed stakeholders in the field of ICT research, like practitioners, politicians, businesses and non-academics in general into the process. This demands besides mutual tolerance and appreciation new standards for academic research in terms of acknowledgement and reputation.

Transdisciplinary research is long-term research, and it is more expensive than single disciplinary studies:

- more human resources are necessary
- difficulties in coordination and organisation
- application of a variety of theories and methods
- development of flexible organisation structures

The development of transdisciplinary research requires efforts on different levels:

- Theoretical
- Methodological
- Infrastructural

While theoretical and methodological efforts are predominately perceived and discussed, the infrastructural dimension is still ignored.

We need an academic milieu which fosters transdisciplinary research. Academic careers still depend on (mainstream) disciplinary work, like publishing in disciplinary orientated journals, and sticking to the set of terminology, approaches, models, and methods of a specific discipline.

It is difficult to motivate young researchers to leave their original field and move towards transdisciplinary research, especially in the field of engineers and computer scientists.

Calls for research proposals are still predominately disciplinary focused, although interdisciplinary orientation is demanded in most forewords. The reviewer system faces difficulties when is comes to truly transdisciplinary proposals.

A new transdisciplinary scientific community for ICT research has to be established. Therefore new platforms for cooperation (e.g. transdisciplinary associations, conferences, journals, networks, etc.) are needed.

2. Supporting empirical research in the field of social implications of emerging technologies

One of the biggest obstacles to empirical research is the lack of accessible data for empirical analysis. Currently available data sets are insufficient in terms of being technologically deterministic and/or too expensive for researchers from an academic environment. Hence it is essential to support efforts in order to create the appropriate preconditions for new empirical research, both on an European/global comparative level and in respect to trans-disciplinary research demands.

In this position paper we suggest support of efforts to implement a Europe-wide monitoring project for the emerging information/communication/knowledge/network society. Already existing efforts and projects in this direction should be unified and transformed into a basic project for a new trans-disciplinary field.

Such a newly established database (on an EU-level, e.g. Eurostat) should provide the indispensable sets of data and indicators in order to meet the demands for trans-disciplinary research. Not only technological indicators (e.g. diffusion of certain technologies into households, businesses) but social, cultural, economic, and other indicators from converging spheres are needed. Only then could empirical research be expected which deliver results

that contribute to the big questions which occur out of convergence and complexity in our society.

We need more ‘qualitative’ quantitative data which allow the combination of socio-economic, cultural, cognitive and technological indicators, both on an individual and a society-wide level and which could be compared on a national and international level. Thus, it is not the technology itself and the empirical data which should be in the center of interest, but the chances and choices of the individual in the current and future society(ies).

The ICT&S Center is highly motivated to actively participate in such an endeavour.

The Natural History of Emerging Technologies: Use Change in the Movement from Science to Domestic

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The origin of the development of many of the technologies that are available today under the generic name of Information and Communication Technologies (ICT) emerged as collective scientific efforts. The motivation behind these efforts has been more than once governmental or scientific divisions that for national security or other reasons needed new approaches and were willing to provide the required funding for the exploration of the problem at hand and even the development.

With time, specific technologies developed for different purposes tend to become more and more integrated. Today satellites, non-wired transmission, cell phones, and computers are integrated in a way that facilitates transmission of data through these different channels. One example of this integration is Geographic Positioning Systems (GPS) which consist of satellites that transmit the position information, the ground stations that are used to control the satellites and update the information and the receiver. The receiver collects data from the satellites and computes its location anywhere in the world based on the information it receives from the satellites. The technology is certainly important, as GPS is being used to measure water vapor in the atmosphere, and to monitor the ionosphere. Most commonly, GPS is used to measure the motion of objects that move too slowly to measure with other tools. This includes things like the flow of a glacier, or the motion of a buoy or research ship in the ocean; the bulging of a volcano as magma flows into the mountain from below, the effects of an earthquake, or even the motion and shape of the continents themselves.

It is very likely that we can trust that the use of GPS for scientific reasons is controlled by professional and academic boards. But recently GPS has moved from scientific use to commercial use. In this area, the convergence of Global Positioning System and digital wireless technologies results in a miniaturized locator that is invading the domestic sphere of life. For less than $200 a parent can buy a wrist-worn locator that provides to the parent cell phone or computer the exact location of the child 24 hours a day. A teen-track cell phone can provide parents the exact location of the teen, and their whereabouts. Other new available systems allow parents to monitor the driving habits and driving speed (you can set limits to the area that the teen is allowed to drive and receive communication when they are out of the area or driving at a speed that you did not agree).

This example shows the changing meanings that emerging technologies can have. They were meant to be used in a different manner than to monitor and track children. Tracking and monitoring behaviour raises social questions, in particular, the difference in socialization using informal and formal social control. Informal social control supports trust and reciprocity, formal social control punishment and formal relationships. The example is provided to represent the need for new approaches in the study of emerging technologies. We need to study the natural histories of technologies and how they change in their movement from the scientific sphere to the commercial sphere. The need for this kind of approach is required as the original ethical, political and social questions are not relevant anymore when society loses control of the technology and makes it available to commercial institutions and the public.

Connecting Policy and Research in a Period of Transition Scale Change: A Role for Future Studies?

Riel Miller

> 'You've got to be very careful if you don't know where you are going, because you might not get there.'
>
> Yogi Berra

Discovering, choosing and implementing policy that works has always been difficult. That is why policy-makers look to the research community to help invent, design, test and evaluate policy goals and tools. Researchers are also interested in policy because it offers a proving ground for theoretical and empirical hypotheses. Despite these common interests it is often difficult to connect the worlds of policy and research. For many reasons the respective agendas, time-frames, methods and outputs often fail to mesh. An important, current example of this problem is in the field of information technology (IT).

Almost everyone has high expectations for IT. IT is expected to be a permanent source of inspiration for innovation and competition, thereby driving up long-run productivity growth rates. IT is the tool that will bridge social divides and solve environmental challenges. In effect, IT is the crowning glory in a series of ever more powerful super-tools: the steam engine, electricity, the automobile. Each in its day evoked and provoked people's imaginations. Only, as we know too well, there is often a wide gap between the dreams and reality.

At first this gap is one of potential versus development. The technology is not mature: many of its refinements and uses still need to be worked out. Then, as it diffuses, to become the moniker of an era, disappointment or post-boom blues sets in. The wonders of a speeding train do not eliminate the problems of anti-competitive behavior. Improved access to electric light in the home does not solve the problem that only some parts of the population bother to read. Greater individual mobility through the private automobile does not mean that every unemployed person can find a job. In the end the tools, no matter how amazing, seem disappointing because they simply reshuffle rather than eliminate many of humanity's basic economic and social problems.

Will IT follow the same path? How can policy-makers and researchers begin to assess the implications of IT development and diffusion over the next thirty years for achieving economic and social goals? What does the policy-maker need to learn from the researcher, and vice versa, in order to understand what IT makes possible? And, on the basis of a systematic analysis of the possible, can we discover the most effective ways to turn the possible into the probable and desirable?

One approach to answering these questions is to explore what kinds of societal changes might make good on a 'disruptive' tool's potential. This is a way to begin exploring the unknown in order to sketch the maps that researchers and policy makers need in order to chart their own paths and where they may intersect. Such map-making can be divided into two categories: the first type involves filling in the details of known territory, and the second calls for exploration of entirely new ground.

Continuity versus Transition

The underlying, relatively uncontroversial argument of this position paper is that there is a role for futures studies (FS) in developing the maps that can bring policy and research into closer

alignment. The contention is that by helping to specify the potential for change, FS makes it easier to develop and link research and policy agendas. Less self-evident is the main contention of this position paper that FS becomes especially pertinent if there is a suspicion (or desire) that change might be on a large or *transition scale*.[37] This is because a period of transition, as distinct from one of consolidation, opens up entirely new (disjunctural) possibilities.[38] In such circumstances FS is an essential tool, not only for assessing if today's incremental changes have radical potential or not, but for tailoring research and policy to take advantage of the potential.

To sharpen my hypothesis, I would contend that in periods of socio-economic continuity or consolidation, when government institutions, organizational rules and problem solving formulas seem relatively clear, it is easier to find congruence between research and policy. This is largely because it is easier to establish strong links when both the policy agenda and the academic paradigms are stable and marked by broad consensus. For one thing, the dominance of particular theoretical models in the academic community tends, probably with a modest lag, to structure the way policy practitioners frame their problems.[39] This, in turn, makes it easier to connect the refinement of existing policy approaches with the deepening of the dominant theories and analyses found in the academic world. All of which creates a virtuous circle where the stability and consensual nature of the policy agenda helps reinforce agreement amongst researchers regarding theory, analysis and data.

By way of contrast, during periods of socio-economic discontinuity or upheaval, when the basic functional and organizational effectiveness of institutions and policies are being called into question, it becomes much more difficult to establish consensus within and congruence between the research and policy communities.[40] The difficulty of linking policy and research during 'transitional' phases is not due to the lack of effort on the part of either policy-makers or researchers to assess the changes that challenge the effectiveness of previous conventions.[41] Periods of transition tend to stir up a wide range of analyses, hypotheses and experiments as everyone scrambles to understand what is going on. Rather, the breakdown occurs because the changes that render past practices less effective also reduce confidence and consensus regarding what will work in the future. As a result, even establishing agendas for collaboration becomes more difficult.

Not unexpectedly, the gulf between research and policy becomes harder to bridge in periods of profound socio-economic change because there is less common ground regarding how best to conduct society's collective tasks. Such uncertainty and controversy over the way researchers should apprehend the world and what policy can and should do, not to mention how, tends to aggravate the divide that often separates the practical imperatives of the policy maker from the more abstract reflections of the researcher. On the government side many get preoccupied with trying to squeeze the last drop of effectiveness out of the old ways of doing business while flailing about to discover which innovative approaches might correspond better to the changing circumstances. On the research side, a similar tension can be found between the 'mainstream' or orthodox schools of thought that try valiantly to fit an altered reality into

[37] Transition scale change is measured against the metric of changes in the way everyday life is conducted. Thus the shift from a rural/agricultural society to an urban/industrial one is a transition scale change because most of the practices and choices that people confront in their everyday lives are completely transformed.

[38] A wide range of authors view the current period as one of 'transition', from business analysts like Peter Drucker (see: Post-Capitalist Society, Harper, 1993) and 'Marxists' such as Immanuel Wallerstein (see: Utopistics: Or Historical Choices of the 21st Century, New Press, 1998) to science journalists like Mark Taylor (see: The Moment of Complexity: The Emerging Network Culture, University of Chicago Press, 2002) to social analysts such as Charles Leadbeater (see: Living on Thin Air, Penguin Books, 2000).

[39] In the economic sphere, the adoption of National Income Accounting and macro-economic policy analysis is a good example of how ideas filter from the researchers to policy makers and then even into popular discourse and perceptions.

[40] Examples, at least from the vantage point of the OECD, are legion at the moment. From sustainability and intellectual property rights to education and industrial policies, the links between research and policy are in considerable turmoil.

[41] Storper, M.: Conventions and Institutions: Rethinking Problems of State Reform, Governance and Policy. In *Institutions and the Evolution of the State*. Edited by Castro, A. C. and Chang, H. J. Edward Elgar, 2000.

old bottles and the upstart or dissident perspectives that are viewed as untested and lacking in legitimacy. All of this is only natural since forging a new consensus, be it amongst academics or policymakers, takes time and typically plenty of conflict.

However, patience is perhaps not the only, nor the preferable, solution. From a number of perspectives it would be helpful to find ways of bridging the gaps—between orthodoxy and innovation within a field as well as between the policy and research communities. The question is how? One way of building the needed bridges more quickly and effectively is to use the scenario techniques of future studies (FS). This nascent field offers a relatively new approach, not only to researching the social implications of technology, but also to building the confidence needed to embrace the experiments and innovation from which intellectual consensus and joint research-policy work can evolve. FS builds confidence because it provides a rigorous way of examining the potential for change that is contained in the present.[42] This, in turn, provides a more systematic and imaginative foundation for assessing what it might take to turn the possible into the probable.[43]

In conclusion to this brief position paper the preceding can be summarised as a question: might it not be helpful, if the task is to try to imagine possible future social systems and the role of future tools in those systems, if there was a more concerted effort to deploy the rigorous imagining offered by the emerging tools of FS?

[42] For example: Miller, R. and Bentley, T.: Unique Creation—Possible Futures: four scenarios for 21st century schooling, NCSL, UK, 2003. http://newportal.ncsl.org.uk/media/F7B/8F/possible-futures-flyer.pdf

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Changing the Context Changes the Social Implications: The Global Response to New Technologies

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While technologies may be the same everywhere, context varies greatly between America and Zimbabwe and between Indonesia and Japan. In low-income countries there are *supply-side* obstacles to the take up of existing technology; in middle-income countries supply-side obstacles are rapidly falling and effective demand is rapidly rising; while in high-income countries the take up of new technologies is likely to be *demand-driven*.

Standard models of diffusion as an S shaped process, starting slowly, accelerating rapidly and then decelerating and flattening out imply: (i) where Internet use has begun to take off (say, 5–25% of the population) it will grow fastest; (ii) where Internet users are already numerous (say, 45% plus) growth will begin to slow down as the limit is approached; and (iii) where Internet penetration is least (less than 4%), supply-side obstacles impede takeoff indefinitely. To understand the social implications of emerging technologies we need to think in terms of a differentiated model.

More users will come from developing countries

Differences in diffusion rates will cause structural shifts in the global population of Internet users. More than 4 billion people live in developing countries, about 1 billion in high-income countries and 1 billion in very poor countries. Thus, in the next few years the global impact of middle-income users in countries such as China, Mexico, Brazil, Russia and literate India will become very substantial. Already, the United States provides only 23 percent of the world's Internet users and the Anglo-American world only one-third of the world's total.

Depending on context, potential consequences of new technologies include:

- Leapfrogging growth by less developed countries. New technologies that enable countries to skip stages of development, for example, mobile phones eliminate the need for high capital investment in phone lines.
- From lagging to catching up. Countries lagging behind world leaders in the percentage of users can catch up by compounding high rates of growth, and new technologies may benefit them by making established technologies cheaper through obsolescence or through technical improvements or both.
- Unbalanced growth. Simple technological determinism based on 'leading' indicators of Internet use, such as GDP per capita, will lose accuracy as predictors of Internet use as countries high in education and/or English-speaking (e.g. literate Indians) will go on line more rapidly and exploit these cost advantages.
- Widening divide. Insofar as emerging technologies demand the supply of more sophisticated and costly resources, a gap will widen between those countries capable of marshalling such resources and those that are not. NB: If aggregate resources are critical, then China and Russia will be better positioned than Finland or Singapore. But if a critical

mass need not be massive, then small pioneering countries may maintain or widen their lead.

From users to useful uses

The underlying assumption of the digital divide literature is that every group in society should have an equal probability of being an Internet user: if 67 or 77 percent of the population are Internet users then the same proportion of uses should be found among men and women, young and old, wealthy and poor, and so forth. An unintended implication of this egalitarian criterion is that it is 'normal' in the statistical sense for 25–33 percent of the population not to be on line. However, digital divide theories often have universalism as their goal, the belief that everyone ought to be on line.

A critical question about the Internet in society is whether its empirical limit is analogous to colour television or the automobile. Today, no one speaks of a 'television divide' because almost everyone sometimes uses television. By contrast, there is no concern about an 'automobile divide' even though a substantial minority do not own an automobile and the lower incidence of car ownership in New York or London than in rural areas is a reminder that some people choose to do without a car.

The paradox of leading countries in Internet use is that the scope for additional users is limited because most of the population is already on line and non-users can be rational. In high income countries it is not ignorance or lack of income but lack of utility that makes people informed non-users.

A *utilitarian model* offers an explanation why some people go on line and others do not: Individuals will use the Internet insofar as its benefits are greater than its costs—and both terms will vary between different emerging technologies and between national contexts.

- In high-income societies new technologies will have marginal utility. When most people in a society have already captured the benefits of being on line with 2005 state-of-the-art technology, further advances will be evaluated in terms of marginal utility. New technologies that increase the efficiency of existing uses will diffuse rapidly, as broadband did, because they make it easier to do what people already want to do on line. New technologies that offer new services will be taken up only insofar as they encourage people to do on line what they already do off line or creating new activities. While new technologies that do not relate to existing uses or change preferences and behaviour may be of scientific and aesthetic interest they will be little used.

- In developing countries, the utility of the Internet is categoric, the difference between being on line or not being on line. Where cost is an obstacle, a 'low tech' innovation will be more effective in recruiting more users and the commodification of the cost of existing Internet equipment through competition can have a great effect on the spread of the Internet. Indirectly, new tech innovations that can indirectly reduce costs of innovations in high-income countries produce a second-hand goods for developing countries. For people facing such obstacles as an erratic supply of electricity, the technological innovations of greatest utility may relate to the cheap provision of electricity rather than high-tech Internet facilities.

Once people in developing countries go on line, the ways in which leading-edge technologies will have utility is contingent on context as well as cost. Even benefits of existing technologies will be irrelevant, for example, shopping on line has little to offer in a country where credit cards are little used, and joined up e-governance faces great obstacles where governmental

records are imperfectly bureaucratized or there are obstacles to linking records between public sector organizations or standardizing the identification of individuals.

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Human Factors in Security

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The need for people to protect themselves and their assets is as old as humankind. People's physical safety and their possessions have always been at risk from deliberate attack or accidental damage. The advance of information technology means that many individuals, as well as corporations, have an additional range of physical (equipment) and electronic (data) assets that are at risk. The IT industry has developed a plethora of security mechanisms, which could be used to make attacks significantly more difficult or mitigate the consequences. But many users are unable or unwilling or to use these mechanisms, or are not even aware of what the risks of not employing these mechanisms are. Security experts such as Bruce Schneier have therefore portrayed people as '*the weakest link*' in their efforts to deploy effective security [12]. But until recently, the human factor in security has been largely neglected both by developers of security technology, and by those responsible for security in their organisations. Kevin Mitnick [9] points out that to date, attackers have been more aware of human factors than the designers of security systems, and have exploited this advantage prodigiously, for example through social engineering attacks. The aim of this paper is to show how human factors knowledge and user-centred design principles can be employed to design systems that are workable in practice, prevent undesirable user behaviour and users being the weakest point of attack.

1. Only usable security is effective security

It is unfortunate that usability and security are often seen as competing design goals in security, since only mechanisms that are used, and used correctly, can offer the protection intended by the security designer. A common reason for users not complying is that the mechanism requires effort that they are not able or willing to take on. A good example is computer passwords: most users today find it impossible to comply with standard policies governing the use of computer passwords [1]. A key principle from human factors is to consider the physical and mental effort a mechanism creates for the user, and minimise it as far as possible. The example of computer passwords also illustrates that we cannot restrict this consideration to single interactions the user has with the system. Remembering a single, frequently used password is a perfectly manageable task for most users. But most users today have many knowledge-based authentication items to deal with: multiple and frequently changed passwords in the work context, further passwords and personal identification numbers (PINs) outside work, some of which are infrequently used. The limitations of human memory make it impossible for most users to cope with this demand [11], and because of this, users write passwords down, share them with others, and chose very obvious ones when the mechanism allows this [1].

Human factors knowledge provides an understanding of human capabilities. User-centred design provides heuristics and methods to fit technology to these capabilities. For security designers, the guiding principle should be to '*make it easy for users to do the right thing*' as far as security is concerned. For the example of knowledge-based authentication, the application of human factors principles and user-centred heuristics would lead security designers, first of all, to the recognition that:

(1) Certain user groups (e.g. elderly users) may have different capabilities; and

(2) Different mechanisms and policies are needed for infrequently used systems.

The standard password mechanism is cheap to implement, and fast for users to execute, and poses no memory problem with frequent usage for the average user in an office context. For other user groups and infrequently used systems, however, passwords and PINs can create significant problems. Here, security designers ought to consider:

(3) *Providing mechanisms that require users to recognise items rather than recall them*. Recognition is an easier memory task than recall, and designers of graphical user interfaces (GUIs) have applied this principle for decades now. Recognition of images [6, 10] has already been used for security mechanisms; but even text-based challenge–response mechanisms and associative passwords [17] can offer improvements over the unaided recall that current passwords require.

(4) *Keeping the number of password changes to a minimum*. Login failures increase sharply after password changes [3, 11], because the item competes with the old one.

(5) *Provide mechanisms that are forgiving*. Current password and PIN mechanisms require that the item is recalled and entered 100% correctly. Reference [4] found that users do not completely forget passwords: most of the time, they confuse them with other passwords, do not recall them 100% correctly, or mistype them on entry. This means that given a larger number of attempts, most users will eventually log in successfully [5].

2. Security is a supporting task

Two further concepts that are key to designing successful security applications are goals and tasks. Human behaviour is essentially goal-driven, so the effective and efficient execution of tasks that help us attain goals is important. Human factors analysts distinguish between *production tasks*, i.e. those that are required to achieve the goal or produce the desired output, and *supporting tasks*, i.e. those that enable production tasks to be carried out in the long run, or be carried out more efficiently, but are not essential to achieving the goal. Security—like safety—is a supporting task. Production tasks are the reason why a system exists, and if production tasks cannot be completed effectively and efficiently, the system will cease to exist. Users naturally prioritise their production tasks; organisations—sensibly enough—do the same from a higher-level perspective. This understanding leads us a number of insights for security design:

(1) *Security tasks must be designed to support production tasks*. Security tasks must not make demands on users that conflict with the demands of the production tasks, and the performance requirements for a security tasks must be derived from the performance requirements for the production task. The current reality is that security mechanisms are often chosen without consideration of the production tasks, and individual users are often left to make a choice between complying with security regulations or getting their job done—with predictable results. The selection of a security mechanism, and how it is configured cannot be left to security experts; rather, such decisions need to be made in the context of business processes and workflow [4].

(2) *Users need to understand and accept the need for security tasks*. In an ideal world, we would have security systems where security is seamlessly integrated and demands no extra effort. We could, for instance, imagine a gait recognition system that identifies users as they walk up to a door and opens it to those who are authorised, remaining shut to those who are not. In reality, however, even a well-chosen and well-configured security mechanism demands extra effort—in the above example, users may need to remember to carry a token that identifies them, and make special arrangements to take visitors into the building. To avoid users' natural inclination to shortcut security, they need to understand and accept the need for the security task, and be motivated to comply (see section 4).

3. Beyond the user interface

The most widely known and cited paper on usability and security—*Why Johnny Can't Encrypt* [15]—reports that a sample of users with a good level of technical knowledge failed to encrypt and decrypt their mail using PGP 5.0 [16], even after receiving instruction and practice. The authors attribute the problems they observed to a mismatch between users' perception of the task of encrypting email, and the way that the PGP interface presents those tasks to users. There can be no doubt that the security community has not paid much attention to usability until recently, and consequently, few tools have interfaces that fulfil usability criteria. Well-designed user interfaces can reduce users' workload significantly: user-centred design of security mechanisms, however, is more than user interface design. The case of PGP [16] presents a good example. The problem lies less with the interface to PGP, than with the underlying concept of encryption (which pre-dates PGP). The concept of encryption is complex, and the terminology employed is fundamentally at odds with everyday language: a cryptographic key does not function like a key in the physical world, and people's understanding of 'public' and 'private' is different from how these terms are applied to public and private keys. This will always create problems for users who do not understand the concept completely. Whilst some security experts advocate educating all users on how encryption works so they can use it properly, I would argue that it is unrealistic and unnecessary to expect users to have the same depth of understanding of security as experts do. Some computing people in the Eighties argued that it would never be possible to use a computer without an in-depth knowledge of electronics and programming; in my view, arguing that all users will have to become security experts to use systems securely is similarly misguided. Concepts and principles that need to be understood by users to work out correct security behaviours must be simple.

4. The role of education, training, motivation and persuasion

Whilst a well-designed security mechanism will not put off users, it will not entice them to make the extra effort that security requires (see section 2). In many home and organisational contexts, users lack the motivation to expend the extra effort. User education and training can be used to explain the need for the extra effort that security requires, but changing users' knowledge and understanding does not automatically mean they will change their *behaviour*. Reference [6], for instance, found that a sample of users with weak passwords had '*received relevant training*' and did know how to construct strong passwords; however, they chose not to comply with the request to construct strong passwords. The first point to make here is that there is a difference between education and training: whilst *education* is largely about teaching concepts and skills, *training* aims to change behaviour through drill, monitoring, feedback, re-inforcement and—in case of wilful non-compliance—punishment. Since social engineering attacks often bypass technology altogether to obtain access or information, reference [9] emphasises that effective security education and training should:

> (1) Not only focus on correct usage of security mechanisms, but also address other behaviours—such as checking that callers claim who they are, and
>
> (2) Encompass all staff, not just those with immediate access to systems deemed at risk.

Many organisations simply provide security instructions to users and expect them to be followed. The material disseminated may even threaten punishment. The threat of punishment alone will not change users' behaviour—rather, if users see that they are not enforced, they lose respect for the security in general, and the result is a declining security culture (see section 5). Even though some security experts advocate rigorous punishment as a way of weeding out undesirable user behaviour, this is not an easy option. Policing undesirable behaviour—detection and punishment—requires considerable resources, can be detrimental to the organisational climate, and may have undesirable side effects (such as increasing staff turnover). Given that sanctions only have an effect if they are applied, and

that there may be undesirable side effects, an organisation would be well-advised to specify sanctions only for a small set of key behaviours that it deems to be putting key assets at risk.

Reference [14] identified a set of beliefs and attitudes held by many users who do not comply with security policies:

> (1) Users do not believe they are personally at risk.
>
> (2) Users do not believe they will be held accountable for not following security regulations.
>
> (3) The behaviour required by security mechanisms conflicts with social norms.
>
> (4) The behaviour required by security mechanisms conflicts with users' self image. (The perception is that only "nerds" and "paranoid" people follow security regulations).

There can be no doubt that security in general, and IT security in particular, currently suffers from an image problem. Education campaigns (similar to those employed in health education) can be only be effective if they make users believe that something they care about is at risk. In the absence of sufficient self-motivation, persuasion needs to be employed. Reference [14] presents some example of persuasion to improve security behaviour in the corporate context, while reference [8] offers techniques for designing applications and interfaces that intrigue, persuade and reward users to achieve desired user behaviour in general.

5. Building security cultures

In section 2, I emphasised the importance for organisations to integrate security into their business processes. In section 4, I argued that the best motivation for users to exhibit desired security behaviour is if they care about what is being protected, and understand that and how their behaviour can put these assets at risk. These two arguments provide the foundation for the next key point: organisations need to become actively involved in security design, and build a security culture as much as a system of technical countermeasures. Even though some organisations understand that risk analysis is the bedrock of security design, many organisations still do not understand the role of security in their business/production processes. Too many organisations still copy 'standard' security policies and deploy standard mechanisms, and leave decisions about security largely to security experts. Security decisions are then often made in an *ad hoc* fashion, as a 'fire fighting' response to the latest threat.

Organisations need to become actively involved in the decision-making about what should be protected, and how. This requires performing a risk and threat analysis and making decisions based on what makes economic sense for the business, rather than trying to meet abstract standards set by security experts. Many companies already use risk analysis methods, but as reference [11] points out, they often fail to consider the interests and needs of all stakeholders—such as users—and the economics of security is currently not well understood.

Once security aims appropriate to the organisation have been established, role models are essential to change behaviour and re-build the security culture. This will require buy-in from the top. Currently, senior managers sometimes exhibit bad security behaviour because they believe they are too important to bother with 'petty' security regulations. Their security experts to whom they have delegated responsibility for the organisations' responsibility are often not able to enforce secure behaviour under these circumstances. I would argue that the responsibility for security—as for safety—should always lie with senior management. Security experts can advise, implement and monitor, but cannot take sole responsibility for making an organisation's security work. An additional approach worth considering is to make secure behaviour a desirable trait. This can be done through social marketing, or by making it part of professional and ethical norms [14].

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New Approaches to Research on the Social Implications of Emerging Technologies

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Which emerging technologies? Incremental changes rather than a radical shift

I have the feeling that many developments in communications will be the continuation of current trends, in at least five directions:

- increased speed and capacity of existing communication equipment (which might be used to enhance the quality of images, sounds and texts rather that the number of programmes, media outlets and information sources).
- continuing miniaturization of communication devices allowing furthermore portability and mobility, but also a greater individualization of communication practices.
- specialization of software and applications for very specific purposes but also emergence of meta-software and meta-applications, needed to make all this work together (especially in the domain of search engines).
- still more pervasion of communication technologies in domestic and everyday life, under the code names of comfort and practicability, especially in the home, shopping and public transportation. Ironically, I am not so sure that E-learning will develop as rapidly as we would expect or wish.
- development of audio applications on the supply side (driven by the fact that information in audio form can be delivered to people while they are doing something else—cooking, driving a car, commuting) and also on the consumer side (vocal commands).

It is difficult to say whether there will be a radical shift in the digital paradigm (i.e. the frame, both technical and mental, which organizes and drives current technical innovation in communications). Yet, on a longer term, some radical changes might occur, especially in two domains:

- how information is saved and stored (new supports such as clothes fabric?)
- some kind of connection with bio-technologies (in my view the real revolution of the 21st century) and cognitive sciences. As we know more about how the brain functions and the chemical coding of information, this might open new perspectives in communication technologies.

Issues: social versus technical concerns

Privacy

I'd like to say that privacy will become a prominent issue and a concern to many people, therefore boosting research and innovations in privacy enhanced technologies. I'd like to say that, after several centuries of struggle for the right to communicate, the right to isolation should be on top of the civic agenda. Yet, it seems that it is not the case and that most people do not really care about the various technologies of control which are in operation (CCATV, data mining, cookies and smart cards being rudimentary examples of the much more sophisticated technologies that will emerge). It may be that the real issue is why people accept so easily technologies of social control (which has probably to do with some structural change in cultural values and especially the conception of what the private sphere means).

Standardization

It will certainly be an important issue in the years to come for a number of reasons.

Some large corporations are engaged in so-called convergence strategies.

Common standards are needed to allow mass production or delivery of communication services and devices.

Integrating communication systems through common standards certainly meets a strong demand from firms (which are seeking to reduce their transaction costs) and from individuals (who want to communicate more easily).

In terms of agenda for social research, one interesting area is how consumers (and citizens) can be involved in standardization processes. For instance, how could a democratic design of technologies be implemented through standards?

The place of developing countries in the global network

In a few decades, many developing countries will be developed countries and this will have a tremendous impact on the global communication world. However, Africa will likely be well behind and that it is an issue which would deserve much attention from the part of social researchers through questions such as: how can information technologies be used to contribute to social and economic development, and how to socialize people in underdeveloped countries to information technologies so as to allow their effective social appropriation?

These are certainly old questions, but they need to be 'reinvigorated' by new, more practical, bottom-up approaches, relying for example on local, social experiments.

New approaches: macro versus micro investigation

Being a political scientist, I naturally tend to focus on the social shaping, social uses and social impact of technologies.

Some lessons from the social studies of technology

In the field of social studies of technology, something nice happened over the last two decades. Fewer and fewer students of technology think in determinist terms, be it technical

determinism (which actually would come in two versions: technology developing on its own logics outside the realm of human agency; or technology having social impacts—for instance, the internet will bring democracy) or social determinism (to put it simply: technology is a social construct; for some radical social researchers, technology is even just symbolics).

When thinking about the digital world, we have learnt not to think in binary terms. Instead, it is now recognized:

- that technology only offers potentialities which might be developed or not, depending on many (social, cultural, economical, political) factors.
- that the actual, mass applications of a given technology are often unexpected and rarely correspond to the applications which were initially envisioned or planned by engineers. Which means that a technology is changed all along the process of its social diffusion and through the ways it is used.
- that the social demand for communication innovations is hard to predict and the parameters which affect demand for information technology are as much cultural as economic.
- that, however, technical constraints do exist and do matter. Technological developments are not just a matter of politics. They are physical limitations to the shaping and uses of technology. Moreover, there is a complex interaction between technical constraints and social uses of technology. Past developments and also previous practices of technology play as technical constraints: they affect how we frame future developments of technology, how we may use next technologies; they determine specific technological paths and lock in users in peculiar socio-technical configurations (as exemplified by the very well known case of the computer keyboard).
- that the same technology will have altogether positive and negative impacts. And also, that new technologies, while providing solutions to existing problems, create new problems.

Studying how people use communication technologies by resorting to ethnographic, socio-psychological approaches

To me, the main 'front' for future social research on communication technologies would be to better understand the uses of new communication technologies by individuals in different micro-social contexts. While quantitative surveys may illuminate part of this, more qualitative studies, combining ethnographic and socio-psychological approaches, are needed.

First, to analyze how people construct meaning by selecting, sorting out, bundling and blending multiple sources of information. In other words, we have to better understand the '*intertextuality*' at work through the use of various communication devices, that is the process by which people interrelate different fragments or pieces of information to make sense of their environment. In this respect we certainly can draw a lot from recent developments in cognitive psychology.

Secondly, we have to look at the strategies and practices deployed by people while using communication technologies and how they relate to other social activities. People are able to develop indigenous tactics and skills in order to customize their communication equipment and get control of the various communication flows they are exposed to. We need to document more the various processes of socialization and appropriation of information technologies. Here ethnographic approaches (for example in the vein of the research done on the integration of technologies in domestic life) are especially useful in that they relate

individual social practices to the micro-social contexts in which people live, work, entertain themselves, and meet friends.

Analysis into the Social Implication of Mediation by Emerging Technologies

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It is a truism today to say that we live in a period of unprecedented technological upheaval. This upheaval—marked, among other things, by the advent of the Internet, the rise of digital convergence, and the spread of wireless technologies—poses many challenges and opportunities for researchers concerned with the social implications of emerging technologies. Around the world, policymakers, business leaders, civil society and individuals are grappling with challenges to their existing policies, strategies and processes. They must confront the often perplexing task of 'translating' current understanding and practices to a drastically new technological environment.

In what follows I argue that much of current understanding about the social implications of communications technologies are based indirectly (and often without acknowledgement) on a concept of 'mediation'. 'Mediation' may also provide for an analytical construct that can be used to better (translate and) understand the social implications of emerging information technologies. Technology-led social implications can be seen, in large part, as arising from changes to the nature and functioning of intermediaries or mediators. *I therefore argue that any attempt to design a new research agenda that informs decision makers could benefit from a closer look at the concept of mediation, and the social implication of new technology-driven intermediaries.*

Mediation and Media. Mediation implicates many roles and functions. Among the most important functions of 'mediation' involves the role that intermediaries play in 'framing' reality and determining access to information. By framing reality and providing access to information, intermediaries in many ways determine our understanding of the world, and decide our capabilities to act in society.

Traditionally researchers have focused on the media as the key 'mediator' in society. It is however fair to say that the media is not the only intermediary: churches, educational establishments, political parties, artists and various other institutions play a similarly crucial role in determining the contours of reality. But the media occupies a particularly central role as an intermediary due to several characteristics, which may inform the importance of mediation in a new technological context.

One particularly important characteristic is that of (technical and economic) scarcity. Scarcity in mediation, real or artificial, provides power in society especially if a dominant mediator can determine the 'frame of mind' or decide access to information. The scarcity of media intermediaries can therefore be understood as the underpinning and theoretical justification for a wide variety of media policies that aims to mitigate the social implications of the media. For example, the multitude of competition laws—including non-discrimination and transparency principles—that make up the traditional regulatory landscape stem directly from an awareness of the scarcity of media producers. Likewise, program prescriptions, public service obligations and subsidies, and must-carry or interconnection laws: all of these can be understood, in one way or another, as attempts to overcome the inherent scarcity of media intermediaries and foster a multitude of views and information sources.

New Technologies and Mediation. The arrival of new information and communication technologies led to a belief that we witnessed a decrease of the importance of mediation and the arrival of abundance. Yet, instead of the widely predicted process of disintermediation that was supposed to accompany emerging technologies, we are currently forced to confront a

process of reintermediation, marked by new actors and methods of disseminating information and framing reality. Likewise, instead of the much-heralded end of scarcity that was supposed to accompany digital convergence, we are finding that new 'mediating' technologies simply introduce new (and often artificial) forms of scarcity. Such technologies include, for instance, content and identity management systems, digital rights management and filter, search and navigation tools. Furthermore, research by Lada Adamic and Bernardo Huberman, for instance, showed that the distribution of visitors per site follows a universal power law, characteristic of winner-take-all markets. In other words, a small number of sites have tens of millions of visitors each month—Google, Yahoo, MSN, etc.—while millions of sites attract only a handful each. Counter-intuitively, the more choices there are, the more extreme the curve becomes, which exemplifies in part the need for mediation within society so as to cope with abundance.

Nonetheless, despite the unexpected nature of the transformation, it is clear that new technologies have drastically altered the landscape of mediation. Yet, we are only on the verge of understanding what the social implications of the new mediating forces might be, and much more analysis is needed. Perhaps one of the most important challenges to focus upon involves the growing relationship between identity and mediation, and the lack of transparency and accountability that has accompanied this process. For example, we increasingly find that access to information and the framing of reality is determined (some may call this customized) by a verification procedure of identity and a subsequent authorization process. The social implications are multiple, including a potential growing polarization and balkanization of society as well as a growing divide to access information depending upon the authorization privileges and rules that are associated with one's identity. As web services and federation becomes more and more integrated in the architecture of the Internet, fuelled by new business and pricing models, and security and compliance requirement, and as computing devices (with ID management systems attached to them, such as RFID) are becoming ubiquitous, the social implications of new mediating tools will only swell.

In conclusion, in considering 'new approaches to research on the social implications of emerging technologies' I would argue to focus upon a research agenda that considers the 'new mediation ecology' as a result of emerging technologies. Such an agenda could translate existing insights on 'mediation' in a new technology context and inform policy makers, civil society and industry to mitigate the social risks of emerging technologies.

Incubator for Critical Inquiry into Technology and Ethnography

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Over the last four years the **Incubator for Critical Inquiry into Technology and Ethnography** (INCITE) at the University of Surrey has begun to explore new ways of working at the intersection of qualitative sociology, design and the development of new technologies. The purpose of INCITE is to encourage innovative and experimental social research on new technologies, particularly from an analytically critical perspective and by drawing on contemporary sociological theory. However we spend a great deal of our time working out how to foster collaborative workshops which involve engineers, interaction or product designers and artists as well as social researchers. As you can see on the website (www.soc.surrey.ac.uk/incite) our mission is to provide a creative interdisciplinary space for research projects which explore the socio-cultural dimensions of technology use and design.

One of the aims of the OII–MIT Workshop is to explore how disciplinary traditions can be *bridged* in order to build multi-disciplinary research. This position paper offers some thoughts on the opportunities of bridge-building drawing on experience working on projects with Intel, Sapient, FujiXerox and the Department of Trade and Industry.

First, we need to find ways of talking about our objects of study and our methodologies across disciplinary approaches and prejudices. Whereas social researchers are often more comfortable talking about textual approaches and written or transcribed qualitative data, designers and engineers often like to think more visually and through objects. For example, keychains are mundane artefacts, yet they have both a designed and social function. A designer might talk about their form factor and affordances, but a sociologist can use them to explain sociological concepts which might otherwise be difficult to introduce in other ways: commuting behaviour, boundaries between home and work, appearance management, domestic division of labour, occupational norms, etc. We need to **create more keychain-like objects** as part of our ways of working. They can be integrated into new kinds of methodology. Working with Intel on a project on ubiquitous computing, we used a public transit (bus) route in order to explain to engineers and designers within Intel the importance of understanding how people experience place as well as mobility though urban spaces, and how emerging technologies (RFID, wi-fi networking) would draw on existing local practices.

Second, we should acknowledge and work with the fact that producing a written report on social implications of new technologies may be less effective in terms of building bridges between disciplines than running design-style workshops and developing forms of studio- and workshop-based practice. We need to **experiment with various forms of translation**. At INCITE we have tried to build up an interdisciplinary way of working which explores ‘studio sociology’, with an emphasis on developing a visual practice around data and analysis in collaboration with engineers and designers. We have brought in graphic designers and those skilled at drawing up initial ideas. We use sketches as much as a way of exploring the process of collaboration—its tensions and opportunities—as final outcomes of the work. For example, in one project we came up with new kinds of public internet access points, derived from people’s experiences in London boroughs. In another we used eighteen months of work in a homeless mother and baby shelter to think about mobility and communication services beyond the cellphone. Experimenting with ways of translating research should push us also to rethink the spatial practices of social research. What can working in a workshop or studio space do for our methodology? How can we explain our data collection and analysis methodologies through such spaces?

Third, through collaborative projects with industry or university-based engineers and designers, each can offer distinctive analytic perspectives and encourage theoretical innovation. **Science and Technology Studies (STS)** has developed an immensely rich and useful literature on technology use and design, yet it seems vastly underused when multidisciplinary collaborations take place. STS has also been at the forefront of the social sciences in experimenting with autoethnography, layered accounts and performance texts, which help with innovating translations. In the INCITE projects, theories from STS have been used as ways to introduce themes from contemporary cultural theory. When advising Intel's UC Berkeley lablette on the Jabberwocky project (http://www.urban-atmospheres.net/Jabberwocky/), we talked extensively about the cultural preoccupation with detection, from medical imaging to the gay cultural phenomenon of 'gaydar' (detecting someone's sexuality). As Intel's interests—in common with many others in engineering and computing science—have evolved from ubiquitous computing to pervasive computing, there is an even greater need to think more widely about the larger cultural agendas that run through collaborative practices, and to draw on relevant sociological theories. Sociologists can also contribute knowledge and analysis of recent social trends. For example, recent work in the UK on the importance of friendship has fundamentally changed the way in which sociologists think about the centrality of the conventional family. Yet in the field of emerging technologies, models of the smart home universally appear to be being designed for heterosexual parents with dependent children (only 22% of UK households, National Statistics, 2004). Yet when such STS and sociological knowledge enters the collaborative process it may be transformed or rejected (hence the need to explore translation). In all these attempts at bridge-building we need to adopt a reflexive outlook. How are we producing knowledge about the technologies as well as the technologies themselves? What happens to social and political (including policy) themes in studio work? A concern with objects and the materiality of design workshops should not leave behind attention to the discursive practices through which our projects are framed and reframed.