Co-Designing for Ethical Innovation

Michael Liegl[1], Alexander Boden[2], Rachel Oliphant[1], Monika Büscher[1], Xaroula Kerasidou[1]

[1] Centre for Mobilities Research, Lancaster University, La1 4YD, UK

{r.oliphant;m.buscher;x.kerasidou}@lancaster.ac.uk

[2] Fraunhofer Institute for Applied Information Technology FIT, St. Augustin, DE

alexander.boden@fit.fraunhofer.de

Corresponding author: Michael Liegl, Michael.Liegl@wiso.uni-hamburg.de

Present Address: Sociology Department, Hamburg University, Allende Platz 1, 20146 Hamburg

Abstract

The ever more pervasive 'informationalization' of crisis management and response brings both unprecedented opportunities and challenges. Opportunities include new ways of collaborating between agencies, breaking information silos and informing emergency planning and response more richly. But this also brings new challenges concerning how to support trust, enable effective measures to keep information safe and to establish its reliability, and safeguard against a creeping spread of surveillance. Recent years have seen the emergence of attention to ethical, legal and social issues (ELSI) in the field of Information and Communication Technology. In this paper we present our approach for addressing opportunities and challenges

arising in socio-technical innovation in crisis management and response in an ELSI-aware manner. We discuss related previous work and the development of our methodology in a research project that aimed at the development of a system of systems for enabling emergent interoperability in large-scale multi-agency emergency response.

Keywords: ELSI, disclosive ethics, collaborative design, ICT, crisis management, methodology

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1 Introduction

Technology has always played an important role in emergency response. Physical technology such as breathing apparatuses for fire-fighters, gloves for medical personnel, guns and body armour for police have protected and augmented the capabilities of emergency responders for many decades. Policy tools, such as incident command systems, too, have shaped the nature of response (Buck, Trainor, & Aguirre, 2006; Moynihan, 2009). What or who can be rescued or protected changes with these technologies, as do the processes and practices involved, and therewith the ethics and politics of emergency response.

Information and Communication Technologies (ICT) are bringing new rounds of transformation. A process of 'informationalising' crisis response and management is currently underway, following in the footsteps of similar developments in other industries and services. In emergency response, informationalisation can support enhanced risk assessment, preventative measures and learning from past events, as well as increased surge capacity, data sharing, communication and collaboration between emergency responders, closer engagement with people affected by disasters and mobilization of 'collective intelligence'. But informationalising socio-economic processes can also engender far-reaching transformations of these processes. In the domain of crisis management, the use of digital radio in over 125 countries in the world[1] and the rise of social media (Palen et al., 2009; Letouzé et al., 2013) have fundamentally changed emergency communications practices, for

[1] http://www.tetratoday.com/news/tetras-love-affair-with-the-asia-pacific

example. Furthermore, when data can be shared more easily and to greater effect, exceptions from data protection regulations may foster surveillance and social sorting and erode values of freedom and democracy. The recent scandal over NSA surveillance starkly highlights the challenges to informational self-determination and privacy arising in the context of IT use in security policy and practice. The ways in which IT are designed and appropriated are deeply entangled with how societies conceive of risks, respond to crises, and facilitate freedom. The informationalisation of emergency response is a form of 'disruptive innovation', that is, innovation that transforms the social, economic, political, and organizational practices that shape this domain (Chesbrough, 2003).

In this paper, we will report experiences and insights from BRIDGE, a large scale European research project that aimed at developing IT systems for crisis response and management. Over the course of the project it became concrete how informationalising socio-economic processes can also engender far-reaching transformations of work practices, including negative and positive **ethical, legal and social implications (ELSI)**. A concern for these often un-intended consequences of technological innovation has long been a subject of study across a range of academic fields. Introna & Wood (2004) argue that especially in the design of ICT systems, ELSI are often silent and opaque, and they propose a "disclosive ethics" method of scrutinizing the ethics and politics of IT systems. From an innovation perspective it would be desirable to find ways of engaging in disclosive ethics *during* design time, which, however, is a challenge, because the un-intended consequences that technological artifacts engender are *relational* in the sense that they arise from interactions between people, the material and design of the artifact, and the context. This poses the challenge of constructing design settings which as closely as possible

resemble real world settings, or even better, following the concept of co-realisation (Hartswood et al. 2008) to bring design into the real world work settings.

The BRIDGE project has been one of the first projects to systematically and explicitly address ELSI in the context of ICT innovation for crisis management and response, bringing analytic, designerly and regulatory perspectives on ELSI together at design time. To identify and address opportunities as well as challenges, such as co-ordinating between multiple stakeholders and work packages across different domains of expertise, cultural and political contexts, we have drawn upon existing research, particularly in participatory design and science and technology studies.

As its main contribution the paper presents our ELSI-Co-Design approach, an approach that builds disclosive ethics into the design of information and communication technology and their adaptation through design in use. It is sensitive to broader proceses of social, organizational and policy innovation. It is a design research approach that appreciates the emergent and contextual nature of values and practices and that seeks to develop methods that enable stakeholders to come forward, to notice and address emergent opportunities and challenges, and to manage conflicting perspectives. The paper thereby defines methods for technology accompaniment based on methodological experimentation in concrete settings.

The remainder of this article is structured as follows: In section 2, we present an overview of existing co-design approaches with a focus on attention to ELSI, as well as approaches to IT regulation. This provides the basis for a discussion of limitations and challenges of current approaches such as *privacy by design*, as well as defining the motivation for a more dynamic and more broadly framed approach to IT innovation in crisis management and response. In section 3, we describe the aims and background of the BRIDGE research project, and give an overview of

methodological “tools” that we have used to make ELSI noticeable and addressable in the design process. Section 4 will then present our experiences from experimenting with our methodology, with a focus on the complexities that arise when ‘disclosive’ attention to ELSI issues is embedded into the design process, and what barriers and opportunities we encountered in the BRIDGE project. Section 5 provides a discussion of our findings with a focus on their methodological implications, before the paper closes with concluding remarks in section 6.

2 Related Work

The last 30 years or so have seen significant attempts to develop approaches for more ethically sensitive IT innovation in a number of areas. This section provides an overview on the most relevant approaches and concepts.

2.1 Design Approaches in Technology Development

User-Centred Design (UCD) arose in the 1980s and presents both a philosophy as well as a broad spectrum of design methods in which the needs of the ‘user’ are central to the design process. UCD is widespread within IT innovation but includes varying conceptions of the ‘user’, ranging from a passive, decontextualized, ‘component’, to an active and knowledgeable actor who is central to the design process (Keinonen, 2008). As an example of a human-centred approach UCD enhances ‘effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance’ (ISO, 2015). However, a serious critique of user-centred design is that it can assume that the beneficiaries of the system (or those at stake) are only those individuals ‘using’ the system.

Participatory or Collaborative Design (PD) takes a broader perspective. It was shaped in the struggles between workers and managers during the 1970s era of rationalization in manufacturing. During this time, new information technologies were introduced into workplaces and hailed as efficiency tools by managers, but they were also resisted as deskilling and – worse – labour replacing by the workers. Of course the reality was much more complex and the effects of socio-technical innovation were transformative, changing the nature of work, markets, and economic systems. PD approaches sought to mediate these transformations with strong ethical and political commitments from the outset (Forester & Morrison, 1990) by involving 'the direct participation of those whose (working) lives will change as a consequence' of new technology (Törpel et al. 2009).

However, while participatory approaches generally attempt to take users' needs, opinions, practices and habits into account as part of the design process, there are vastly differing ways in which this is done. Moreover, experiences in PD reveal how 'new ways of working' emerge alongside new technologies (Bjerrum and Bødker 2003). This means that design may have to continuously evolve in close alignment with emergent new work practices. Approaches of co-realisation develop a synthesis of collaborative or participatory design, ethnomethodology (a particular form of sociological enquiry) and organizational innovation. They move the locus of design and development activities into the settings where technologies will be used, emphasising that design also happens in and through use and recommend longitudinal involvement of ICT developers in the 'lived work' of users (Hartswood et al. 2008). The notion of giving users appropriate space and tools for participating in envisoning and designing (technological) futures (Sanders & Stappers, 2008 p. 12) is significant, especially with a view to the ethical and societal implications on socio-technical innovation. Participatory Design started out as synonymous with

cooperative or collaborative design, based on an emancipatory conviction that diverse users should be involved as as equal as possible actors (Greenbaum and Kyng 1991). It has since been augmented with approaches that specifically develop methods for the co-realisation of socio-technical futures, responding to the emergent and transformative nature of innovation (Hartswood et al 2008). When we refer to our approach as co-design, we reference these traditions, convictions and methods. Co-design enables the imagining, experimenting with, negotiating, finding, defining and making 'desirable' futures. By building on broad-based, rich and interdisciplinary discussions about values, aims and means, co-design, joins design with design in use (Ehn 2008) and becomes an ongoing, collective effort and responsibility.

Participatory approaches within ICT systems design have also been influenced by Computer Supported Cooperative Work (CSCW) (Grudin, 2008; Schmidt & Bannon, 1992). CSCW is primarily concerned with understanding the practices involved in making cooperative work go well for the purpose of designing computer technologies that can enhance cooperative work in a world where it is arguably becoming ever more distributed and complex. One of the key insights of CSCW is that one cannot understand people's practices as something planned and rule 'governed', but rather needs to appreciate order as a situated practical achievement (Suchman 2007). People may orient to plans and rules, but adapt them. Therefore one has to design 'for' human practices of order-making. Here CSCW has affinities with co-design, including an ethical concern for designing for humans through a 'commitment to designing systems (both technical and organizational) that are informed by and responsive to people's everyday work practices' (Kensing and Bloomberg, 1998 p. 180).

Value Sensitive Design (VSD) is another highly relevant approach. Developed in the late 1980s and early 1990s within the fields of human-computer interaction and

information systems design, VSD attempts to offer a “theoretical and methodological framework with which to handle the value dimension of design work” (Friedman et al. 2013). It combines concern for issues such as privacy, ownership and property, physical welfare, universal usability, informed consent, autonomy and trust, etc. in a systematic way throughout the design process. In this context ‘value’ refers to ‘what a person or group of people consider important in life’ (ibid p.2). In practice, VSD consists of conceptual investigations asking which direct and indirect stakeholders are affected by the design, what values are implicated and how should trade-offs among competing values be negotiated. These are complemented by “empirical investigations of the human context in which the technical artefact is situated”. A wide range of qualitative and quantitative methods help to further specify conceptual considerations with contextual and situated information (Friedman et al. 2013).

Finally, Science and Technology Studies (STS) provide useful theoretical and methodological resources for thinking through issues of technology, participation and ethics, including the ‘possibilities and limits of participation in technology development’ (Törpel et al., 2009). While STS includes a number of different theoretical traditions, it has long had a focus on ‘democratising technological culture’ (Bijker, 2003) and in making science and technology ‘socially responsible’ and ‘accountable to public interests’ (Sismondo, 2008b:18).. The emergence of the STS ‘engaged program’ [ibid.] has followed broader institutional shifts in how ‘publics’ and their relationship with science and technology have been conceived. From the late 1990’s a ‘participatory turn’, saw public engagement, dialogue and more participatory styles of governance become central paradigms within the science and policy worlds (Felt & Wynne, 2007). This included the emergence of many different participatory models and practices including public debates, consultations, citizen conferences and other experimental forms. STS scholars have both participated in

and provided critique of these participatory processes, as well as offer possibilities for new types of ‘collectives’ (Latour, 2004), ‘collective experimentation’ (Wynne & Felt 2007) and ‘co-production of knowledge’ models (Callon, 1999). These experiments offer the potential for opening up new spaces and theoretical resources for negotiating the politics and ethics around ‘matters of concern’.

2.2 Regulatory Approaches to IT Innovation

Along with designerly and STS approaches to practicing ethically and socially circumspect innovation, the last 20 years have also seen the emergence of a range of regulatory approaches. Regulatory measures include Recital 46 of Directive 95/94 of the European Union (1995), the first European directive on data protection, which aims to embed ‘appropriate measures’ in ICTs ‘both at the time of the design of the processing system and at the time of the processing itself, particularly in order to maintain security and thereby to prevent any unauthorized processing’ of personal data’ (Pagallo, 2011). Currently (in the EU) regulatory approaches for the assessment of IT innovation are being developed and institutionalized including in 2012 a proposal by the EU Commission for a new general data protection legal framework that has not yet been adopted[2]. In addition, there have been a range of other regulatory approaches including Privacy by Design as well as privacy and ethical impact assessments (PIA, EIA). This section briefly outlines these different approaches, followed by a discussion of the resonances and tensions between regulatory and designerly approaches.

[2] The regulation has not yet (June 2015) been adopted. The regulation will take effect two years after its adoption, at the earliest 2017.

Privacy by Design is closely related to the concept of ‘privacy enhancing technologies’ (PET) (Information and Privacy Commissioner/Ontario, 1995) and aims to incorporate mitigation of issues such as data protection and privacy into the design of technology. In practice, this might include design features such as separating ‘personal identifiers and content data, the use of pseudonyms and the anonymization or deletion of personal data as early as possible’ (Schaar, 2010:267). A number of countries, including Canada, Germany, the Netherlands and the United Kingdom are promoting Privacy by Design. The European Union’s Seventh Framework Program for research and technological development (FP7)—the EU’s chief instrument for funding research over the period 2007–2013—also emphasizes the importance of “building in” privacy safeguards in technological solutions. Proponents of Privacy by Design argue that the principles should be binding for technology designers, developers and data controllers (Schaar, 2010 p. 278). However there are also criticisms of the concept including questions around its feasibility in practice (Spiekermann, 2012).

Legal risk analysis focusing on privacy is another approach that is commonly referred to as a Privacy Impact Assessment or Data Protection Impact Assessment (PIA) (Clarke, 2009; Wright et al., 2012). PIAs have been developed and used in a variety of countries and contexts (occasionally mandatory), since the early 1990s including in Australia, Canada, Ireland, New Zealand, the UK and the US (Wright et al., 2012). The 2012 proposal for a new general data protection legal framework encompasses a number of detailed provisions for all ICT systems processing personal data. Making PIAs mandatory will likely lead to a significant increase in the use of PIA across the EU and beyond and it has been suggested, may ‘give momentum to the development of an international standard’ (Wright & Friedewald, 2013). As yet however, the methods to carry out detailed PIAs vary and while there are various

guides there are currently very few PIA methodologies (although a number of projects are attempting to develop this). Usually PIA processes are multi phased and carried out in several iterations, as the system develops. The initial objective is to get an overview of the main problem areas and stakeholders, as a basis for further assessments and deliberations of the system design. This often involves identifying 'risks' to privacy and strategies to overcome them.

Last but not least, Ethical Impact Assessment (Harris et al. 2011; Wright et al., 2012; Wright, 2011) is a more recent development from the fields of philosophy and theoretical ethics, following in the footsteps of other 'impact assessments' such as environmental, risk or regulatory impact assessments and technology assessment (TA). A central emphasis is on the need to consider 'ethics in context rather than on prescriptive rules' and thus far has been largely a reflective method, where questioning the ethics of individual technologies and their implementation accompanies the design and development process. Often this literally involves the asking of questions, and there have been various attempts to formulate sets of questions to uncover ethical issues (Marx, 2006; van Gorp, 2009; Wright, 2011). It has also included attempts to develop key principles, as well as procedures, frameworks and other 'ethical tools' for 'assessing the ethical impacts of new and emerging technologies' (Wright and Friedewald 2013, p.762).

These regulatory approaches have seemingly been developed in isolation from the designerly debates outlined above. This leads to problematic oversights and a preoccupation with a rigid 'assessment' focused on 'problems' without any clear means of translating insight into creative innovation, but it also introduces valuable contributions, which are not addressed in design so far. Most importantly, ethical impact assessment can scaffold sustained engagement with ethical issues. Rarely is attention extended to the creative appropriation of technology and the ethical

consequences of this, and cumulative effects of assembling ecologies of technologies or, as in our case ‘systems of systems’. There is however also a strong emphasis on including stakeholders and the importance of debate in the process. Wright and Friedewald have highlighted the overlap between PIA and EIA and suggest that both can be done together in what they call a P+EIA process (Wright & Friedewald, 2013).

2.3 Towards Design for Privacy & Design for Design

For the authors, the above review of existing designerly and regulatory approaches was motivated by the need to respond creatively to ELSI opportunities and challenges arising in socio-technical innovation in large-scale multi-agency emergency response and interoperability. The above highlights the well known fact that the design of technological artifacts is not finished after an official design ‘phase’, but that important adjustments happen in the appropriation, when the artifact is installed and implemented in the (so called) “real world” (Orlikowski and Hofman 1997). A lack of respect for this evolutionary nature of innovation and the needs, practices and contexts of end-users has contributed to the loss of billions of Euros and innumerable hours of work. Examples include the half a billion pound failure of the UK Firecontrol project (Committee of Public Accounts, 2011). More seriously, in the domain of crisis management and response insensitive innovation can put people’s lives at risk (Shapiro. 2005) and directly and indirectly erode privacy and civil liberties. In 2007, for example, the US Federal Emergency Management Agency (FEMA) inadvertently disclosed the Social Security numbers of Disaster Assistance Employees on the outside address labels of reappointment letters.[3] In the context of major incidents, where emergency services, commercial utilities and telecoms

[3] http://breachalerts.trustedid.com/category/federal-emergency-management-agency/

operators and government agencies may have the need and – with new ICT, such as those developed by the BRIDGE project – the means to share information more extensively and intensively, the challenges of controlling data flows are heightened (Büscher et al 2015b).

Regulatory approaches like *Privacy by Design* have a tendency to neglect the transformative momentum of innovation, demanding ways of building processing constraints based on existing work practices *into* the technology, seeking to disable functionalities that would be unlawful or enable unlawful practices. This, creates tensions in emergency response, where adherence to data protection laws can and should be suspended for instance when it is in the in the vital interest of affected persons, when it is necessary for carrying out a task in public interest, in the legitimate interst of the controller, etc. (EU Data Protection Directive 95/46/EC, Article 7). Such tensions can often not be solved completely by technological means, but require negotiation and dialogue amongst different kinds of stakeholders (not just users and technology developers, but also the public). This is especially the case for a sensitive domain like emergency response with its high stakes and the strong need for operational improvisation and exception. Hence, we would argue that regulatory approaches need to be complemented by co-design, which means that we need to invent ways in which certain technological artifacts *in use* enable ethically and legally circumspect practices. For this purpose, co-design needs to be re-thought as ELSI Co-Design, which means that ethical, legal and social values should be put on equal footing with functionality and usability, instead of just being considered as implicit side-aspects of the design.

Drawing this particular discussion to a close, we see fruitful resonances between design and regulation. In a way, regulatory efforts are forms of meta-design – attempting to spell out protocols and rules that can guide negotiation and

appropriation. The designerly approaches we have described along with ethical impact assessment and legal risk analysis call for iterative engagement of diverse actors, from emergency management and response practitioners to lawyers, social scientists, designers, software developers, policy-makers to members of disaster affected publics. The aim of such engaged efforts should be to inform design decisions, experiment with prototype solutions, find ways of noticing and anticipating emergent effects of innovation in a way that place designers and users in a position to address these effects, to take opportunities and to mitigate problems from a position carefully situated right in the midst of change. We need a synthesis of these different approaches and a toolbox that allows more conscious utilization of them.

The BRIDGE project has drawn on the theoretical and methodological insights of these different approaches in developing what we are calling *ELSI Co-Design*, which will be introduced in the following section.

3 Doing ELSI Co-Design: The BRIDGE project

Our ELSI co-design methodology was developed in the context of a large European research project concerned with IT system innovation for interoperability in large-scale emergencies. In this section we provide an overview on the aims and methodology of the BRIDGE project.

3.1 Background

The overarching goal of the BRIDGE project was to design a System of Systems architecture that would allow emergent interoperability for interagency collaboration in large-scale emergency response. Here individual systems would continue to be integrated and enabled to communicate, share, gather and display information in a

usable, secure way. This involved the development of middleware infrastructures to enable autonomous systems to ad-hoc integrate into systems of systems, interoperate and thus share information, synchronize processes and merge certain functions. In particular, this integration would provide a shared overview of the situation at hand and the combined resources available, but also allow the (partly automated) synchronization and coordination of workflows.

In addition, the project also involved the development of advanced HCI techniques for the exploration of high-quality information. This included, for example, an SOS application that allows people to use their smartphones to advertise their need for help (Al-Akkad et al, this volume), a system which assists first responders in increasing situational awareness by supplying real-time visual and other information on the disaster and its consequences, and systems that support resource management and create and manage workflows to support coordination in the response effort. An overview of the systems is available in (BRIDGE 2015) and technical details are described in a range of publications available from the project's website (BRIDGE).

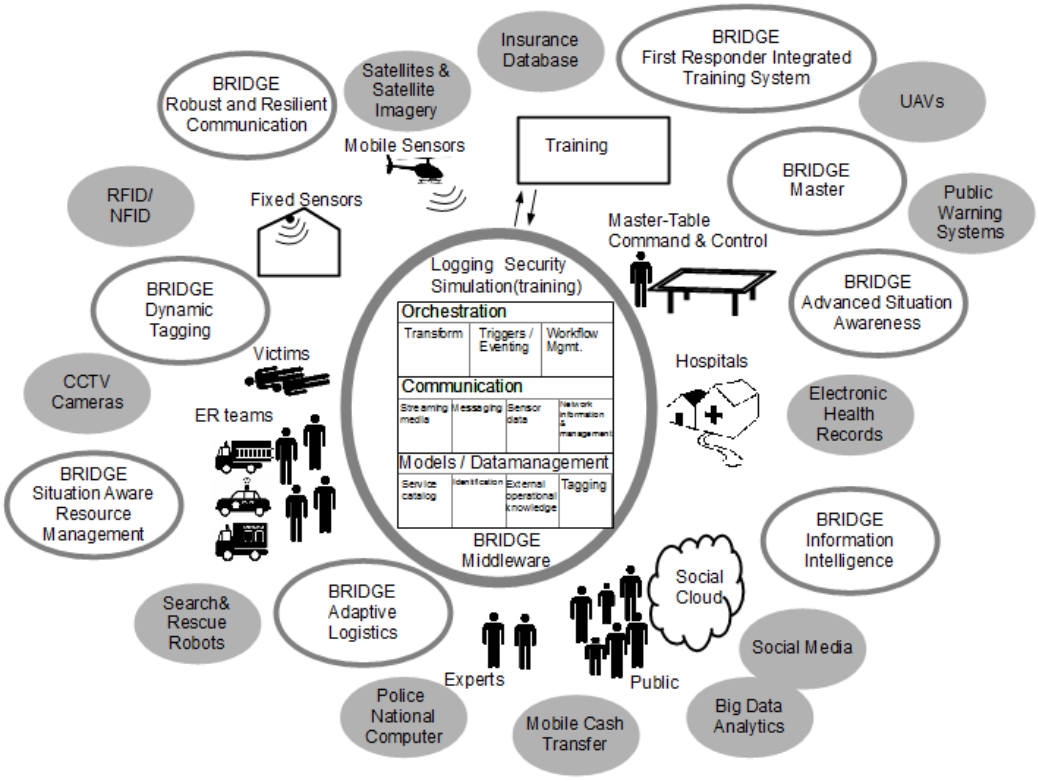

Figure 1 BRIDGE System of Systems

Figure 1 shows the middleware infrastructure services developed to support flexible assembly of information systems for emergency management. This built on existing systems (grey in Figure 1 below) but also included a set of novel systems developed by the BRIDGE project team.

BRIDGE innovations offer a means for assembling systems of systems that can leverage cumulative benefits from diverse technologies and data sets. Individual system functionalities, including mechanisms for automation and expert system components have been designed in close collaboration with users, and BRIDGE systems have clear structures and processes for secure and privacy preserving data collection, processing and sharing. The aim is to give people advanced, useful and usable technological support, enabling them to do the individual and collaborative

work of emergency management and response more effectively, efficiently and safely. Overall the aim is to enhance emergency responders' capabilities to address crises and collaborate, thereby strengthening the security and safety of citizens as well as their privacy and civil liberties.

However, it will not be surprising that such architecture, due to its emergent character, the ability to track and monitor resources, and aggregate and share data also has the potential for raising many ethical legal and social issues. These include, for example: how to share and at the same time protect personal data and the privacy of those involved? How to avoid situation awareness turning into surveillance? How to deal with the potential change in organizational structure that such situational awareness tools might bring about? In addition, the vast scale of the project, involving EU wide socio-technical systems (of systems), multiple project partners and many diverse 'end users', groups or 'publics' potentially impacted by the technology pose unique challenges for addressing these issues. As such, to enable the articulation of ELSI issues and more crucially, to allow the folding in of insights into the processes of design and innovation has necessitated methodological innovation.

3.2 Methodological Approach

The methodology, which we call ELSI Co-Design, uses an iterative, experimental research and development approach that integrates ethnographic observations and insights from user engagement and co-design into specification, integration and experimental implementation of new technologies. This methodology developed and applied in the BRIDGE project was inspired by the concept of disclosive ethics (Introna, 2007). However, rather than analysing already fully implemented systems, ELSI Co-Design aims at disclosing ethically relevant aspects of socio-technical

systems during design time. The leading hypothesis in this method is that neither the actual usage of technology nor potential ethical issues can be known in advance, but rather in the coming-together of practices, stakeholders (i.e. everyone directly or indirectly affected) and socio-technical systems ethical implications become imaginable, experienceable, and can be articulated. It is therefore not at all sufficient to analyse formal features of a technology using similarly formal formulations of ethical principles and values to disclose ethical implications. Rather than a pre-existing checklist of issues already known, ethics then is an emergent phenomenon, a matter yet to be negotiated and similarly unknown as the socio-technical futures to which it belongs. Ethics of such socio-technical systems then isn't so much something t be checked (that already exists) but rather something that needs to be constructed and formulated. For this we propose the analogy with co-realisation, where a new technology is designed in negotiation of technical feasibility and current practices. In other words, we will bring our current ethical intuitions when we explore technological prototypes-in-use, but in the process that ensues, both technology *and* ethics are *under construction.* ELSI Co-Design then means to construct environments, where technological black-boxes can be opened, the complex effects of technology-in-use becomes observable and ethical implications related with such use / practices can emerge so that it becomes available for the discussion by diverse publics. Drawing on the notion of "living laboratories" (REF) we hope that in such environments experiments can be conducted where elements – such as prototypes-in-use, ethical principles, diverse stakeholders interact in in ways that will provoke such observable reactions (Figure 2).

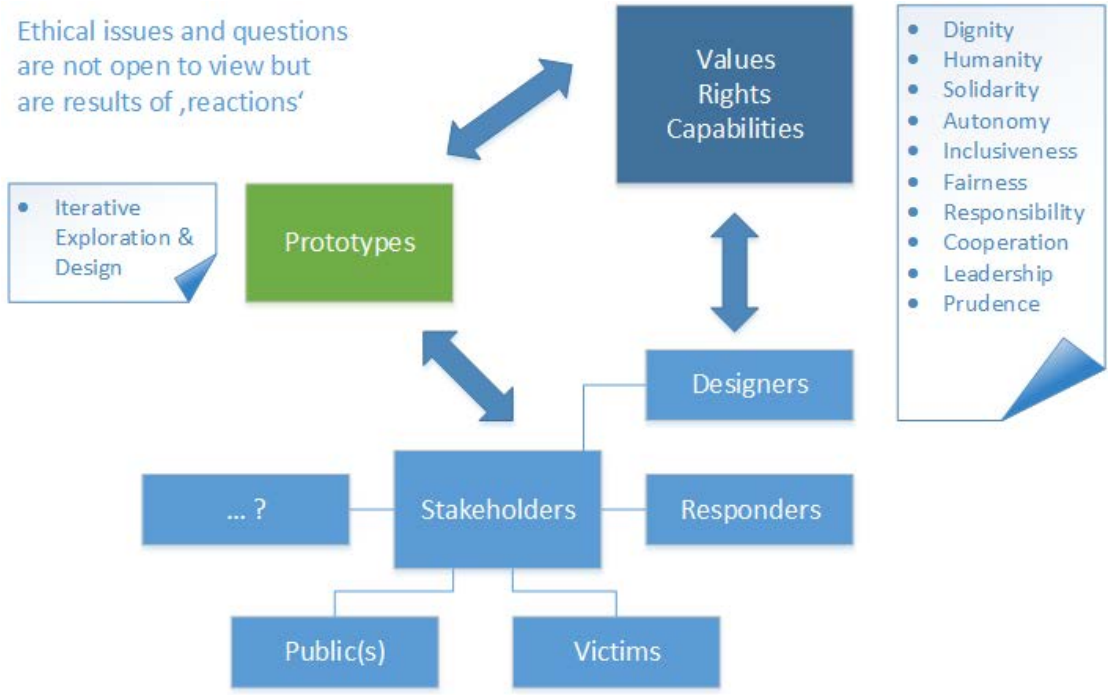

Figure 2 Disclosive ethics, living laboratories

For our methodology we contended that just like ‘usability’, ethics cannot be assessed or decided by experts, but has to be the product of engagement with the technology, by directly or indirectly implicated publics. Facilitating such publics is a central element of what we call ‘ELSI Co-Design. We therefore used a whole spectrum of participatory and user-orientated design methods, where designers, users and researchers become productively entangled and users become critical collaborators in the innovation process (Sanders & Stappers, 2008). This included ethnographic domain analysis, prototyping and co-design, scenario based demonstrations and Living Laboratories.

Furthermore, informing socio-technical innovation is not a linear process where insights clearly necessitate certain design decisions. We therefore aimed to explore ethical, legal and social issues *throughout* the life cycle of the project, pursuing different *modes* of investigation and design, as we will present in detail in the following section.

4 Co-Design Phases and Findings

The methodology of the BRIDGE project can be roughly divided up into three phases, each one offering ethical issues to be articulated in different ways. These three modes or phases were:

- Ethnographic domain analysis and Co-Design with stakeholders
- Disclosive ethics sessions with engineers and designers
- Validation with end users and long term engagement

Throughout this process, the ethical implications of the BRIDGE system of systems became more and more obvious, complex, but also increasingly tangible. In this section, we will describe the implementation of these phases in detail, with a focus on the complexities that arose when ELSI issues were embedded into the design activities, and on the obstacles and opportunities we encountered in the process.

4.1 Ethnographic Domain Analysis & Co-Design with Stakeholders

In the first exploratory phase of domain analysis, we conducted ethnographic fieldwork in various areas of the emergency domain to understand current practices of inter-agency collaboration and areas for improvement, focusing on procedures, organization, skills and concerns of domain experts. The domain analysis was complemented by co-design workshops, where we engaged mostly with emergency response personnel, encouraging participants to engage in sandboxing exercises, playing through scenarios using paper or more advanced prototypes of the technology we were developing. Compared with fieldwork, such workshops feature a strong futuristic element, in that they allow one to imagine doing things differently. At the same time, they also allow for conflicts or concerns to get expressed or even

discovered in the first place. These workshops elicited user needs, qualities, functional and non-functional requirements of collaboration technologies. Last but not least, in this phase we participated in real world exercises where we were able to introduce BRIDGE prototypes and observe how they were used and tried out in the context of regular emergency response practice. This offered first responders the opportunity for hands on experience with the technologies, allowing both ethnographic observations and extensive feedback of the user experience, insights on its usefulness, input for improvement but also hesitations and warnings of potential dangers of the technology.

Figure 3 Co-Design Workshop

With regard to ethical aspects, this first phase was driven by questions of privacy and data protection, obvious areas of ethical and legal concern in the context of a system of systems architecture that aims to enable organizations to share data ad hoc and at ease. Since processing of personal data is by default prohibited and only allowed under exceptional circumstances, risk analysis of such a system would suggest to physically embed standards for personal data processing into the system. However, as we have argued in 2.3, such attempts of Privacy by Design (Langheinrich, 2001,

Cavoukian, 2001) are not without problems, especially in the exceptional circumstance of emergency response, where flexibility, judgement and circumspection are required to achieve proportionality, appropriate levels of granularity in the data and appropriate degrees of persistence. Hence, we did not attempt to solve the issues of privacy and data protection by merely designing “hard” technological barriers *into* systems. Instead, we focused on designing support *for* privacy management that had to be in tune with people’s actual, existing and emergent practices of negotiating privacy boundaries dynamically and with reference to multiple contexts and rationalities. In other words, the disembodiment and dissociation of current personal data production, collection and processing became a focus for innovation aiming to support people in making such practices more transparent, accountable, traceable, and, where necessary, reversible or delimited in time and space.

During those opportunities for end-user engagement, one thing became immediately clear: the ethical, legal and social implications of the technology went far beyond privacy and data security questions. Playing through scenarios with BRIDGE prototypes, emergency response professionals articulated a large variety of reactions, from enthusiasm, to ambivalence, to strong concerns about information overload, as well concerns about the possibilities of using cooperation support technologies also for surveillance of response efforts. It became more and more clear, that the same technologies that were meant to provide a better awareness in the sense of a common operational picture would also allow to monitor response activities in a highly granular way. The field practitioners clearly saw the potential for such support tools for the micro- and macro-management of response work, but also feared the data could be used to monitor their work very efficiently, leading to ethical concerns regarding informational self determination as well as the creation of legal

accountability in areas that were previously characterised by a merely operational logic. If the complexity of a disaster situation calls for improvisation and “bold” measures, a fine-granular log file of each decision that was taken could potentially lead to a situation where a first responder would feel like he should ‘play by the book’ because he could be held accountable for any action (or lack thereof) later.

From these diverse research and design opportunities we derived collections of in vivo quotes, observations and user stories, featuring users’ problems, hopes, fears and ethical considerations that came up in connection with scenarios involving BRIDGE technology. At this stage however, the prototypes users could engage with were still very immature, allowing to prompt mostly conceptual responses, rather than responses grounded in practice. Hence, we learned a lot about how a certain use or functionality of the system could be problematic, but had little opportunities for a joint engagement that would provide clues as to how to address these issues. Increasingly it became clear that for this we would need more ‘real’ settings in which experimentation with the prototypes could take place - in other words, a further move toward an ELSI version of Co-realisation (Hartswood et al. 2008).

4.2 Disclosive ELSI Sessions with Engineers and Designers

The second phase of the project focused on formulating empirically grounded ELSI design requirements for the BRIDGE System of Systems. This was done through Ethical Requirement Sessions, which brought together the social scientists (domain analysts and IT law specialists), computer scientists, designers and engineers in the project to analyse the various technology bundles (systems) in respect to their ethical, legal, and social implications. In these Ethical Requirement Sessions two kinds of spokespeople engaged with each other: the systems designers/owners represented the “concerns” of the socio-technical system (functionality, technical

details, scripts), while the domain analysts represented the stories, scenarios and concerns they had collected from various stakeholders. While we spoke only amongst project partners, these sessions nevertheless attempted to explore the ethical implications of the technology for all imaginable stakeholders (i.e. victims, first responders, bystanders, response organisations, the 'general public' etc.). The voices of these stakeholders, albeit not physically present were represented by the social scientists who drew on interviews, observations, previous co-design sessions and literature.

The sessions also involved discussing the systems along a number of ethical qualities, also known as virtues, principles, rights or values, and which had been compiled from a study of emergency and disaster ethics. These qualities served as a heuristic tool for these sessions, which included exploring whether – and if yes, how - they surfaced in the use of the system.
Following the sessions, a reflective analysis based on recordings and transcriptions of the discussion was conducted, which flowed into design, requirements specification, validation and evaluation.

The goal of these sessions was twofold: On the one hand we wanted to disclose in a participatory process the implications that might be hidden in the socio-technical system and its (many possible) lived realizations. The assumption was that these implications would only show themselves in use, which is why we played through crisis scenarios with stakeholders and engineers, feeding into those scenarios a sensitivity for ethical, legal and social concerns. The result of this were complex challenges and opportunities that might ask for technological answers, but often also pointed to a need to adjust or pursue innovation in practices, policy, regulation, education and training or public engagement, which required a broader ethico-political focus.

With these evolving sensitivities, we explored the feasibility (and limitations) of technical, social and socio-technical ‘solutions’ and sought to embed ways of addressing the issues raised into BRIDGE socio-technical innovation. Technically, some progress could be achieved by excluding certain options, setting defaults (e.g. privacy by default), striving for transparency and accountability in computational processes, implementing anonymisation, encryption and exploring options for containing data flows (especially in cloud solutions) and forgetting data.

The Ethical requirement sessions resembled most closely representative democracy, where the indirect mode was mostly due to the complexity of the technological systems. We would have favored to pursue a co-realisation approach all the way, and means to continuously include users and stakeholders as experts for their work, who would at the same time be familiarized with the technology. Instead we found that in a trans-disciplinary and transnational project where project partners are dispersed and partners from end-user organization due to the requirements of their actual work only limitedly available, the realities didn’t always match this.

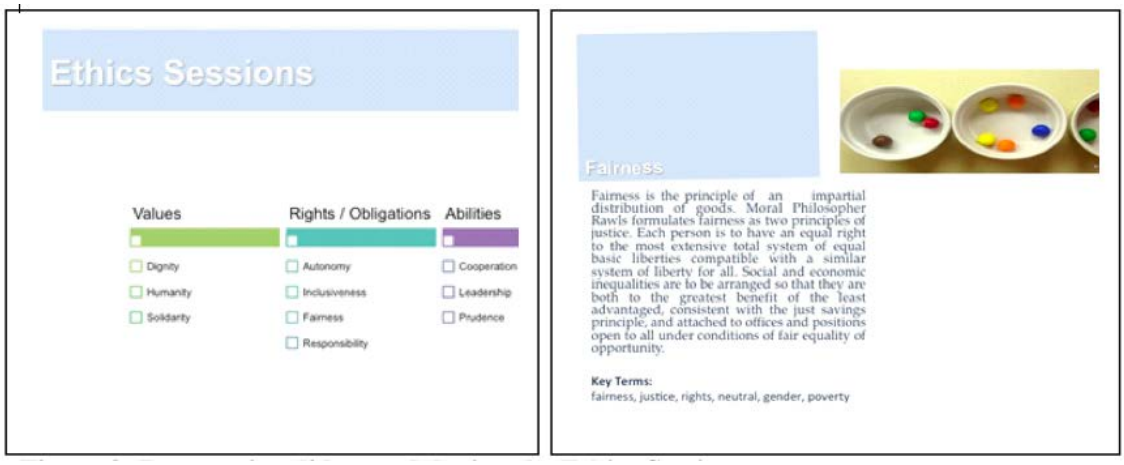

Figure 4 Powerpoint slides used during the Ethics Sessions

Since we talked with designers trying to elicit ELSI system requirements, inevitably the focus turned a little onto the technology. We found it an important heuristic and

rhetorical device to engage designers in ethical explorations of their design to assume that technology is not neutral and that the design might have certain undesirable ethical effects. Insofar, while we spoke about socio-technical innovations, socio-technical systems and practices our analysis tended to look for *where* things are happening, and hence, *where* issues could be addressed. This phase to a certain extend had a techno-determinist bias, that is, we were looking for ethical implications of the technology, trying to allocate responsibility and find potentially technical solutions. Nevertheless, for a lot of issues designers insisted that they need to be addressed in terms of human behaviour which resulted in discussions on the allocation of responsibility.

The following examples are meant to illustrate what kind of issues we encountered during this part of the process.

4.2.1 Who is responsible? Human, System, Middleware?

In the BRIDGE System of Systems, various systems gather, process, share and store information, and the issue often arises where in the system data protection should be located or, to put it in ethico-legal terms: who (which element) would be responsible for this? A command and control system like the BRIDGE Master, for instance, serves as touch screen interface to many of the individual systems and

gathers, aggregates and visually displays information.

Figure 5 The BRIDGE Master System

The ethical discussions that we had with the designers circled around several questions. 1) Personal data might be helpful or even necessary for the response effort, and as we have learned, under certain exceptional circumstances it is permissive to process and even share that data. However, in an emergent system of systems, the question is, where and when the individual systems should make this data available. 2) If personal data is indeed shared, it is a legal requirement that the system must, prior to its use provide a complete list of categories of people whose personal data may be shared and the purpose for collection. In a distributed system like BRIDGE the question then is, where to establish this list of categories and purposes and which system is responsible for it? 3) Who should be able to have access to the information that is shared? Since the system is making this information available, it again is a question how to manage who should be able to see these resources and information. Would it be the user interface itself or is it the

responsibility of the operators of the interface who supposedly are authorized to see this information, to manage visibilities locally in terms of allowing access only to certain authorized and registered personnel?

Anonymization and access control are complex topics in a system of system which aims at enabling emergent interoperability (i.e. integrating additional organisations and their systems in an ad hoc fashion). In our project, the question of responsibility would often turn into a game of 'passing the buck' between systems, but also between systems and users. Addressing it required inevitably a negotiation between (hard-wired) technical solutions, and designs which support socio-technical privacy practices. Access management for instance could be implemented in the system architecture as a formal decision support feature, making users aware of technical, legal or regulatory regimes, plans and social/ethical constrains that may affect operations".

4.2.2 ELSI and the interdisciplinary culture(s) of an innovation project

The ELSI sessions also shed light on the different relevances and values, but moreover terminologies of computer scientists and social scientists in the project. This became prevalent, when trying to re-specify general ELSI values in regard to the BRIDGE socio-technical systems. Discovering that we use the same terminology with radically differing meanings helped to disclose interesting ethical dilemmas. For example, when we discussed the necessity for transparency and accountability of systems to assure autonomy we ran into vastly different interpretations of the concept of 'transparency'.

In the world of IT the black-boxing of processes is often referred to as 'transparency' or 'seamlessness' (Weiser, 1991, 1994). This vision of 'invisible' and intuitive computing is seen as a benign design philosophy that protects the user from

unnecessary complexity, aiming to enhance the usability of IT. This, however is in stark contrast with another notion of transparency which actually means the opposite – that processes ought to be *visible* for the user, reflecting what is going on under the hood and thus empowering users to make changes on the fly. This concept has been discussed as accountable, seamful, or palpable computing (Dourish, 2001, Chalmers, 2003, Büscher & Mogensen, 2007). The tension between these two notions of transparency within the BRIDGE System of Systems plays out especially prominently regarding the resource management and adaptive workflow generation systems, which algorithmically automate the coordination of potentially myriads of resource allocations. While this supports unprecedented efficiencies, these vast numbers of processes are impossible to monitor at a human scale which in turn makes it difficult to know who (which part or stakeholder) is responsible and liable for a process.

During these Disclosive Ethics requirement sessions ethicists encouraged designers to think about how a detected issue could be addressed in designerly ways. A common reaction during these sessions was the tendency to ‘pass the buck’ on to another part of the system or from ‘technology’ to ‘practice’. We read these evasive tendencies as symptomatic for how challenging it is to think of responsibility and agency in socio-technical terms, rather than in dichotomies of ‘the human’ / ‘the user’ or ‘the system’ / ‘the technology’. For us, as will become clearer, these negotiations were very helpful both in terms of mapping the system (and conceptualizing the difficulties of its very mappability) as well as conceptualizing post-human embodiment in socio-technical practices.

4.3 Into the Wild: Validation with End Users and Long-term Engagement

In the last phase of the project we organised three very different settings for end-user engagement with our current prototypes. In one setting, we had an exercise with local firefighters, testing the behaviour of by now quite usable prototypes in real world settings; in another, we had a more conceptual validation of the middleware and the workflow management system, where we explored possible strengths and effects of the middleware; while in a third setting a simulated 3D scenario was built, which allowed a virtual exploration and testing of the Master System, eTriage and the training system.

Based on these results we were engaged in yet another iteration with the designer, working on consolidating all the knowledge gathered throughout these varying forms of engagement. These events also helped to establish new relationships with first responder organisations who were willing to engage with some of our most mature prototypes in their everyday work over a longer period of time. These activities multiplied the amount and kinds of people and social entities who will come in contact with the systems, thus multiplying the opportunities for issue- as well as publics-formations around it.

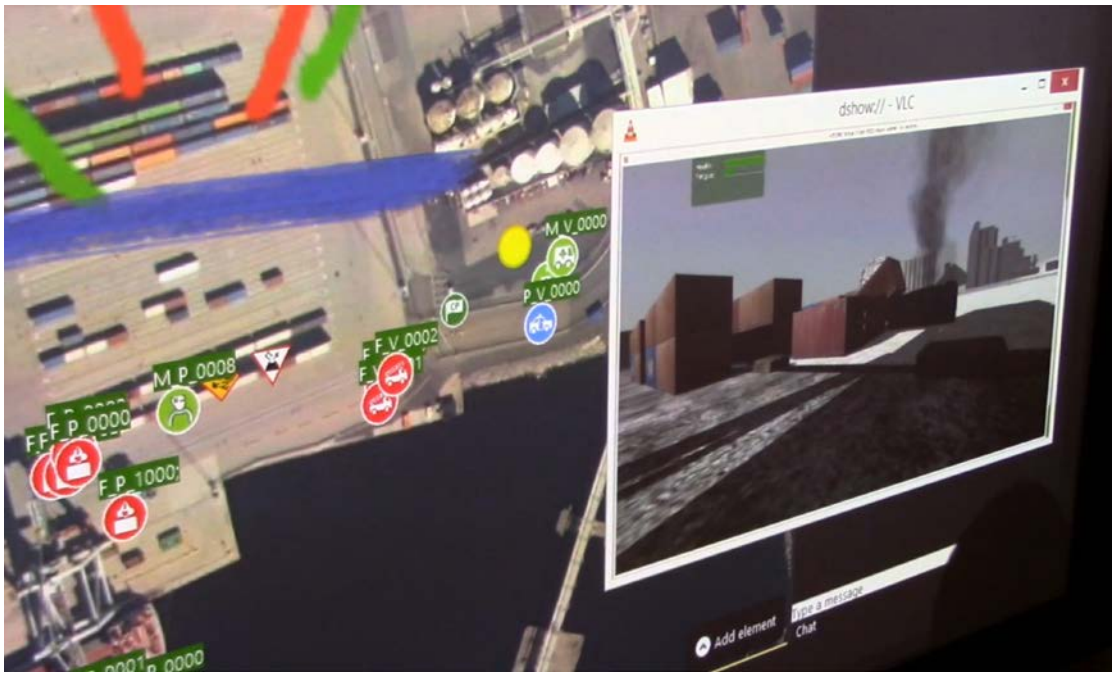

Fig. 6 BRIDGE Training System

In the last phase, the training system gained prominence as a tool for showing the whole system in action in a simulated environment (which, in practice, was very hard to achieve because auf different levels of technology readiness and the organisational problems of organizing large scale technology demos). The training system is a combination of a training methodology and various technical systems which enable the users to embody the technology and become embodied in the technology more circumspectly.

While the training system before had been mostly explored in terms of ELSI issues arising *in training*, we discovered its potential as an investigation tool *for* disclosive ethics and ELSI Co-Design (or even co-realisation) and the training of socio-technical practices, which in our opinion is a central element of design. Using the training system as a design tool allows us to address questions like how to make the firefighter aware that he/she is sharing data, is being seen by incident command, etc. “Feeling” this would allow him/her to use discretion, micro-adjust and micro-manage

for instance privacy, as she would do in an ‘analog’ environment. It would allow her to take into account that her actions are co-composed with technology and understand non-human participation in this deeply morally relevant action.

The training system with its simulation functionality thus became conceptually important as a possible method for the prolongation of design into the use settings as suggested in concepts as design after design (Ehn 2008) or technology accompaniment (Verbeek 2011).

5 Discussion: Disclosive Ethics in Co-Design

Within the BRIDGE project, the different modes of ELSI Co-Design that we have used served as a means for turning matters of fact (“does it work?”) into matters of concern (“is this really what we want?”) (Latour, 2005). We have identified collaboration in emergency response as a vital societal and ethical goal, spelled out the obstacles and fears that currently prevent or stifle efficient collaboration and addressed potential unintended consequences and ELSI of the very systems that enable collaboration. In this section, we will discuss various implications of our findings, starting with practical considerations to more conceptual ones.

5.1 Bridging roles and perspectives

Disclosive Ethics and ELSI Co-Design is an exploration of how socio-technical design and innovation could help to overcome these obstacles and enable collaboration in ‘good’ and responsible ways. Such a threefold innovative process: co-realising technology, practices, but also *ethics* required creating experiential spaces around our technological prototypes, allowing for the exploration and inspection of emerging socio-technical practices, the formation of publics and the articulation and negotiation of ELSI issues. To construct such settings which make

ELSI experienceable, visible, inspectable, however is again not at all a trivial design challenge (cp. Sanders & Stappers 2008). In the BRIDGE project we addressed this challenge throughout the project in ways that varied according to the different design phases, each allowing for its own kind of ethical deliberations. In co-design workshops and real world exercises where first responders 'used' mock-ups or working prototypes playing through response scenarios many ELSI became directly observable to the ethicists, but also strategic level (command level??) experts, or where reported by the first responders in debrief interviews or focus group sessions. This worked especially well with systems that are well aligned with current procedures such as communication technology, map based overview (resources) technology, or other systems requiring a direct interface enabled interaction with the user. It becomes more tricky where the systems are distributed, in the background or involve autonomous agents, such as in the middleware and the workflow management system.

Middleware infrastructures in comparison have no direct contact with users, they are complex, designed to be invisible, operating in the background, opaque, distributed, and black-boxed. How to make a system tangible whose whole purpose is to be in the background, without any direct user interaction? For this we found it would need sensitivity and skill on the side of the designers to build environments in which the middleware could be experienceable for respective users. However, such an endeavour seemed to go against the intuitions and current work practices of system designers. When the design paradigm aims at hiding the inner workings of technology so they don't get in the way of practitioners work, or when – such as in the case of middleware – the technology is assigned to work autonomously in the background, devising ways of making these processes inspectable and accountable for the user seems counter-intuitive. The ethicists hope for a visualization tool that

would help to map and make accountable the way information is being shared and distributed in the middleware. The way the workflow management system allocates resources led to bewilderment on the part of the system engineers, who objected that a) the whole point of such a system is that it runs in the background and b) that such a visualization would technically not be possible (or too cluttered to be helpful). Such examples show that a lot of negotiation and especially translation between designers, engineers, stakeholders and social scientists / ethicists is necessary and the ELSI design of a technology can not be delegated to one kind of expert, but has to happen collaboratively in a way where the various participating groups more and more share their tools (Sanders & Stappers 2008). In the BRIDGE project we found one desideratum that designers not only aim at functionality but be trained to design tools for ELSI Co-Design.

5.2 Saving Lives

In emergency response and management there is an awareness of often operating in exceptional circumstances where the usual regulations such as for instance the prohibition of processing of personal data etc. don't apply, and where the concept of 'saving lives' always serves as an overruling argument. This is an attitude we encountered with first responders and designers for IT systems in ER alike: We are saving lives, compared to this it's not so important whether people's right to privacy is harmed. Hence, first responders and designers who count on their technology being used in a state of exception where mostly anything goes will be reluctant to take seriously both the request to engage in disclosive ethics AND to react to the resulting ELSI. So ELSI Co-Design is about tickling designers' and engineers ambition, not to be satisfied with orienting at what is allowed, but to aim for designs which enable ethically aware and responsible practices.

On the basis of our experiences in the BRIDGE project we are convinced that ELSI Co-Design takes time, but also involves new interdisciplinary methods. There are some parallels here to issues with user involvement in co-design where it is important to empower users to articulate their needs and participate in technology development processes (Wulf & Rohde, 1995), which might require training and the involvement of change agents in order to bridge the “symmetry of ignorance” (Fischer, 2000) that often characterizes such cooperation (because technology developers have trouble understanding the problem space of the users, while the users have trouble understanding the technical solution space). Analogously then, for ELSI co-design it would be important to sensitize users and designers alike for ethical issues, and in this educational process, ethicists are fellow students whose main job is to facilitate spaces and opportunities for these explorations. That way, sensitivity for the ethics of the technology at hand is developed and we feel every project should go through these phases in order to establish in the long run an ELSI aware design culture.

An exploration of the ethical impact of emergency technology can help to sensitize designers, prospective users (including the publics and communities emergency responders serve) and policy-makers to ethical impacts – good and bad – that technology might contribute to in crisis management. However, while it provides a useful overview of issues, it simplifies the ethics of informationalising emergency response and can lead to an innovation impasse. Designers and users can get stuck in a ‘pass the buck’ loop, where one holds the other responsible for undesirable effects.

5.3 ‘Solving’ ethical issues

In the end, the question is what such ELSI Co-Design could achieve. Would it be a success if at the end of a design project the products would be ethically sound and in some way ‘approved’? Throughout this paper we have been arguing for the situatedness and the specificities of ELSI and were cautioning against check-lists and other formalizations which should suggest that findings are easily generalizable and transferable, and such a solution would be possible. Against technical (or regulatory or designerly) ‘solutionism’ (Morozov, 2014) we have insisted that ELSI sensitivity ought to be a basic task and a shared skill in system development. Design processes not only have to be more inclusive of users, stakeholders, publics, but also need to be regarded as ongoing and unfinished.

Morozov warns against seeing IT as a *panacea* and, more generally, narrowing the frame of innovation to fighting inefficiencies: ‘Solutionism [interprets] issues as puzzles to which there is a solution, rather than problems to which there may be a response.’ (Paquet, quoted ibid). Yet, there is a risk when dealing with ethical, legal and social implications of technology to again resort to a kind of solutionism as is implied by privacy by design or even EIA and PIA, for these procedures all aim at finding solutions for potential ELSI and implementing them at design time.

Another aspect of solutionism is the use of and desire for checklists in ethical assessments. While such lists are useful sensitizing tools for the design process, they also tend to turn into bureaucratic technologies. Checklists already delimit the areas and questions which are to be asked off the technology, making it a top down tool (just as top down functional requirements) which runs the risk of losing the situated specificities of the technology and the domain. A technology might fulfil all the requirements and still not be useable just as it might fulfil all the (general) ethical

requirements, and still have undisclosed undesirable effects that were overlooked because of the lack of a disclosive engagement. Another objection goes in the same direction: there is a general argument of unknowability (we cannot know in advance the way technology is used and the way it will interact with its socio-technical context) and a more specific argument of: we don't know enough about the way such technology for emergent interoperability can be used, (if it works / under which circumstances it may work) and what its ethically relevant effects may be. Another reason of course is that especially in modern democratic societies ethics is a moving target and is very much an object of ongoing political negotiations and conflicts of interest. It is therefore more important to figure out ways of navigation and negotiation rather than rigid solutions in form of checklists (does / does not comply).

As we have seen, the ethical implications of BRIDGE technology require technological, but also social and political responses, during and *after* design time. In that sense, solutionism is the goal to solve problems beforehand and once and for all, rather than thinking in terms of navigating or negotiating an issue, developing sensitivity etc. Rather than aim for solutions then, we tried to aim for developing technology that would enable such socio-technical skills to practice emergency response in such cyborg settings more aware and carefully.

5.4 Co-designing across borders and with publics-future directions?

While in the BRIDGE project we involved project partners and other 'stakeholders' such as end users, due to the limitations of the project we were unable to directly involve the many others that may also be impacted by, or come into contact with the technology, including the broader 'public' who may have concerns or thoughts about this technology and its use. While we did not involve these public(s) directly, we attempted to bring such considerations to the forefront of the project, to feed in

findings from our research activities and to highlight the wider societal implications and wider public(s) role throughout the BRIDGE project. This raises important questions about what role citizens should have in research and development projects, especially in the context of identifying ethical and social issues and how practically they might be included.

Furthermore, who is the public, and is it really as singular, univocal and homogeneous as usually imagined? (Delgado, Kjolberg, & Wickson, 2011). Acknowledging that there are multiple public(s), raises further questions about how we might practically co-design with such dynamic and heterogeneous partners. Efforts to broaden participation in innovation have wider societal implications not only for project budgets and timelines but also in terms of broader efforts for more democratic involvement in the development of technologies inviting us to seriously consider the extent to which publics could be included in research and innovation projects and how we, as researchers, achieve this practically and well, in light of the many critiques of participation (e.g. Irwin 2001, Wynne 2006). Furthermore, these issues challenge us with questions of politics, i.e. of the power asymmetries of such collaborations pressing on questions such as: if publics are multiple, who and how can be included in the innovation process, and who is to make these decisions? How do we navigate (because we cannot escape them) issues of representation and who can stand in for which public(s)?

6 Conclusion

The BRIDGE project is one of many attempts to leverage the potential of advanced information and communication technologies (IT) for crisis response and management and is part of broader transformations taking place within emergency management around the world. Embedding new IT technologies within emergency

management will inevitably entail transformations in how emergency services and others access, share, reason about, communicate, engage with and embody information. This has broader societal implications, not only for the social and material practices of emergency responders, for the ways that agencies and institutions collaborate and work together, or for how it might enhance or impact broader EU effectiveness and humanity in responding to crisis, but also because technologies deeply affect ethical, lawful and socially responsible conduct. They are an integral part of how ethics, legitimacy and social responsibility can be practiced (Büscher et al, 2015a) and therefore offer ambiguous potential for shaping both desirable and undesirable futures. This includes the potential for enhancing collaboration and co-operation and for increasing the security and safety of citizens, but with lack of attention to issues such as accessibility, surveillance or social sorting it could also enhance inequalities, eroding societal virtues such as fairness, equality, freedom and justice.

In the BRIDGE project we responded to these challenges through an interdisciplinary and collaborative socio-technical approach to design and innovation, which we called ELSI co-design. This approach has provided the opportunity for deep engagement with these issues through the concrete exploration and experimentation with technologically augmented practices of emergency response. Such concrete explorations can help us understand better how ethics is distributed between people, technology, and the economic, social and cultural environment. The BRIDGE project therefore has sought the disclosure and emergence of ethical, legal and social risks, opportunities and challenges throughout the project, in practice and through collaborative co-design processes involving project partners, designers and developers, emergency services personnel and end users. This approach acknowledges that there is no one size fits all approach for how to do science and

innovation in more ‘careful’, responsible or democratic ways. That ethical, legal and social concerns are not just a checklist at the end of a project, but an integral and essential part of the innovation process. It also acknowledges that innovation is not just a technological endeavour done by experts to be transferred to the social, but is rather a socio-technical exploration that involves diverse stakeholders who should have a role in the shaping of desirable futures. Crucially, we see in this approach a shift from for example, privacy *by* design towards designing *for* privacy, collaboration, trust, accessibility, ownership, transparency etc., acknowledging that these are emergent practices that we cannot control, but rather that we can help to design *for*.

The BRIDGE project has been driven by the desire to not only find socio-technical solutions to problems within emergency response management. It also sought to explore the whole ‘opportunity space’ opened up at the intersection of social innovation of emergency response collaboration in order to ‘Do IT more carefully’, that is, to design IT in ways that fold in better understandings of the ethical, legal and social issues that relate to IT supported emergency response. Exploring such opportunity spaces opens up the potential for cutting edge and, at the same time, ethically circumspect information and communication technologies that augment professional practice as well as public security and resilience. Projects like this are often seen to sit on the boundaries between “‘science and society’, as though these are worlds apart, or as ‘science in society’, as though science is a separate enclave” (Stilgoe 2015: 7). A sufficiently rich understanding of ELSI in technology design is nearly impossible through studies *of* potential users and use contexts alone. Ethical design of disaster IT requires researching and designing *with* users grounded in a more hands-on understanding of current practices. The BRIDGE project has generated a new ELSI-co-design approach that enables new ways of working

together that acknowledge all participants' situatedness within a force field of complex interdependencies and potential transformations (Suchman, 2002).

7 ACKNOWLEDGMENTS

The research presented here is part of the BRIDGE and SecInCoRe projects, funded by the European Union 7th Framework Programme under (BRIDGE) FP7-SEC-2010-1 Theme: SEC-2010.4.2-1: Interoperability of data, systems, tools and equipment, Grant agreement no.: 261817 and (SecInCoRe) Topic SEC-2012.5.1-1 Analysis and identification of security systems and data sets used by first responders and police authorities, Grant agreement number 261817. We are grateful to our colleagues in these projects for many inspiring conversations.

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Vitae

Alexander Boden is a post-doc researcher at the Fraunhofer Institute for Applied Information Technology (FIT). He holds a PhD in Information Systems from the University of Siegen as well as a Master in Cultural Anthropology from the University of Bonn. In his research, he focuses on how ICTs can support coordination and knowledge exchange in complex contexts such as global software development, cross-agency collaboration in emergency response, as well as in open source and maker communities. Alexander publishes in research communities such as CSCW, HCI and Software Engineering.

Michael Liegl is post-doc researcher at Hamburg University. In his research he investigates the interplay of technology, spatial organization and social relations with a focus on the layering and

hybridization of online and offline collaboration using (video-) ethnography and STS. He pursued this interest in research on digital urban art collectives, freelance nomadic work practices and location based social networks. Recently, he was engaged in domain analysis and participatory design as well in the exploration of social, legal and ethical implications of IT supported emergency response in EU 7FP funded Bridge project http:/bridgeproject.eu/en.

Monika Büscher explores the digital dimension of contemporary ‘mobile lives' with a focus on IT ethics. She combines qualitative, often ethnographic studies of everyday practices, social theory and design through mobile, experimental, ‘inventive' engagement with industry and stakeholders. An analytical orientation to intersecting physical and virtual mobilities, blocked movements and immobilities of people, objects and information drives this work. Monika's most recent research brings this perspective to the informationalization of large-scale multi-agency emergency response, which raises opportunities and challenges around social media-based public engagement, agile and ‘whole community' approaches to disaster response, data sharing, data protection and privacy.

Rachel Oliphant is a Research Associate at the Centre for Mobilities Research,Lancaster University. Her work here has focused on two EU funded projects, where she has been part of a team exploring the ethical dimensions of IT supported emergency response. More broadly she is interested in community responses to crises and the potential for collaborative design and community engagement.

Xaroula Kerasidou is a Research Associate at the Centre for Mobilities Research, Lancaster University. Her research interests lie within the field of feminist science and technology studies where she focuses on the material and semiotic practices of technoscience. She works on the EU FP7 funded projects BRIDGE (http://bridgeproject.eu/en) and SecInCoRe (www.secincore.eu) and explores the social, legal and ethical implications of technology.