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Designing for ethical innovation: A case study on ELSI co-design in emergency

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Abstract

The ever more pervasive 'informationalization' of crisis management and response brings both unprecedented opportunities and challenges. Recent years have seen the emergence of attention to ethical, legal and social issues (ELSI) in the field of Information and Communication Technology. However, disclosing (and addressing) ELSI issues in design is still a challenge because they are inherently relational, arising from interactions between people, the material and design of the artifact, and the context. In this article, we discuss approaches for addressing such 'deeper' and 'wider' political implications, values and ethical, legal and social implications that arise between practices, people and technology. Based on a case study from the BRIDGE project, which has provided the opportunity for deep engagement with these issues through the concrete exploration and experimentation with technologically augmented practices of emergency response, we present insights from our interdisciplinary work aiming to make design and innovation projects ELSI-aware. Crucially, we have seen in our study a need for a shift from privacy by design towards designing for privacy, collaboration, trust, accessibility, ownership, transparency etc., acknowledging that these are emergent practices that we cannot control by design, but rather that we can help to design for—calling for approaches that allow to make ELSI issues explicit and addressable in design-time.

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. Collaboration tools, such as incident command systems, too, have shaped the nature of response (Buck et al., 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 (Büscher et al., 2014a, 2014b, 2014c, 2016a, 2016b). 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'.[1] 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[2] and the rise of social media (Palen et al., 2009; Letouzé et al., 2013) have fundamentally changed emergency communications practices, for 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 scandal over NSA surveillance starkly highlights the challenges to informational self-determination and privacy arising in the context of ICT use in security policy and practice. The ways in which ICTs 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).

The often un-intended consequences of technological innovation have long been a subject of study across a range of academic fields. Introna and Wood (2004) argue that especially in the design of ICT systems, ethical, legal and social issues (ELSI) are often silent and opaque, and they propose a "disclosive ethics" method of scrutinizing the ethics and politics of ICT. However, it is this opaqueness that makes it very challenging to address disclosive ethics during design time, especially since 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. Open ended design approaches like co-realization (Hartswood et al., 2008) address the emergent nature of human-technology relations and its politics (Beck, 2002), but often lack a focus on 'deeper' and 'wider' political implications, values and ethical, legal and social implications arising between practices, people and technology.

However, in fields such as emergency response, where values such as humanity, solidarity, equality, trust, and dignity can play a literally vital role and exceptions to normal legal and political process may apply, there is a need for ethically sensitive innovation. This requires designers to attend to broader processes of social, societal, organizational and policy innovation. Hence, design approaches need to explicitly appreciate the emergent and contextual nature of values, ethically sensitive and lawful practices and enable stakeholders to notice and address emergent opportunities and challenges, and to manage conflicting perspectives. This poses the challenge of constructing design settings which as closely as possible resemble real world settings, or even better, to bring design into those real world work settings, as well as coordinating across multiple domains of expertize, and bridging cultural and political contexts. Organizing and facilitating such an ethically sensitive design process we found difficult to implement in our own work (Büscher et al., 2013, 2014a, 2014b, 2014c).

In this paper, we extend debates on disclosive ethics by investigating ways of addressing potential ELSI of informationalisation at design time. Apart from the literature, our paper is based on experiences of doing ELSI-aware collaborative design in BRIDGE and SecInCoRe, European research projects aimed at developing IT systems for large scale crisis response and management (Liegl et al., 2015).[3] 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 and offered an ideal setting for exploring such issues and experimenting with design (and other) solutions, bringing analytic, designerly and regulatory perspectives on ELSI together at design time. SecInCore builds upon these efforts and seeks to develop 'live, lived, living' ELSI guidelines as an evolving, co-created resource for innovation in risk governance (Büscher et al., 2016a, 2016b). Reporting our experiences of developing an ELSI aware co-design approach, we highlight challenges and opportunities that we hope will help other researchers operating in similarly sensitive domains, and contribute to the development of co-design methodologies that include ethical issues in more explicit and comprehensive ways.

The remainder of this article is structured as follows: In Section 2, we present the background for our research by providing an overview of the domain of ICT in emergency response with a focus on the ELSI-related challenges and issues that can arise when ICTs are developed and used in this domain. This discussion sets the stage for Section 3, where we investigate existing designand regulatory approaches, particularly in participatory design and science and technology studies, and discuss them with regard to their approach to ELSI issues. Section 4 then presents findings from the BRIDGE project as a case study that illustrates our experiences with approaches for making ELSI noticeable and addressable in the practice of designing ICT for supporting emergency response. In Section 5, we draw the different parts together by discussing of our experiences against the background of related work that has been presented in the previous sections. Section 6 closes the paper with a discussion on the methodological implications for the state of the art of ELSI in emergency response, as well as with concluding remarks about future research directions and potential other application domains.

2. Background and domain

In this section, we provide a review on the current state of the art in developing support systems for emergency response and discuss both the ELSI challenges characteristic for this domain and more specifically the challenges related to the use of collaboration technologies. As an example for such a complex support system we introduce the BRIDGE Project which will serve as a case study for our discussion of approaches for ethical innovation in the following sections.

2.1. Technology support for emergency response—enabling interoperability with systems of systems

Emergencies call for the swift and accurate mobilization of information about the incident (what happened, to whom, what needs to be done to help?) and the mobilisation of resources to address the emergency. Unsurprisingly, information and communication systems have become an integral part of emergency management. While praising the efforts of communities and emergency responders, many post-disaster reviews find that there are serious shortcomings in the ability of the diverse actors involved to collaborate and coordinate their efforts (ENISA, 2012). Examples range from not enough boats being available for rescue missions during Katrina (Committee on Homeland Security and Governmental Affairs, 2006), to the impossibility for responders to communicate between underground and above ground teams after the London bombing (Barnes et al., 2006).

A Europe-wide review of multi-agency emergency response reveals that a lack of interoperability is a critical flaw in emergency response (ENISA, 2012). This is a serious problem in a century that has been labeled the century of disasters (eScience, 2012), where an increase in frequency and severity of disasters is to be expected, a growing, ageing and increasingly urbanized population is becoming increasingly vulnerable, and financial resources to maintain public emergency services are shrinking. Emergencies are characterized by their un-ness—they are unexpected, unknowable in their complexity and at least temporarily uncontrollable (Crichton 2003, cited in McMaster and Baber (2008, p. 6)). Emergency responders need to flexibly form adhocracies of response organizations appropriate for the tasks at hand, the need systems that support emergent interoperability (Mendonça et al., 2007).

To share information, responders need support for flexible assembly and orchestration of a 'system of systems' appropriate for the specific emergency at hand (NATO, 2006; Zimmerman, 2013). The utilization and synthesis of information requires collaboration and information sharing between actors e.g. through emergency management information systems, common information spaces or Precision Information Environments (Boulos et al., 2011; Schmidt and Bannon, 1992; Turoff et al., 2004). Following the US Department for Homeland Security, system of systems can be described as a mix of human and non-human constituents:

A system of system exists when a group of independently operating systems—comprised of people, technology and organizations—are connected, enabling emergency responders to effectively support day-to-day operations, planned events, or major incidents (US Department of Homeland Security and The US Department of Homeland Security, 2004).

Assembling systems of systems for emergency collaboration 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 (for a summary of the potential of BRIDGE system of system innovation, see Büscher and Wahlgren (2015)).

In the next section, we will introduce the BRIDGE system of systems as an example for how such a supportive technology can look like. Aspects of the research processes of its development will be discussed later.

2.2. The BRIDGE system of systems

The overarching goal of the BRIDGE project was to design a system of systems architecture that would allow for 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 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., 2014), 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 (Büscher and Wahlgren, 2015).

Fig. 1 shows the middleware infrastructure services developed to support flexible assembly of information systems for emergency management. This built on existing systems (gray ovals in Fig. 1) but also included a set of novel systems developed by the BRIDGE project team which are highlighted as white ovals with gray borders in the figure and are described in detail in Table 1.

By providing a flexible assembly of various existing systems and novel tools, the BRIDGE system of systems aims at providing a collaboration ecology in which various organizations can interoperate, share information as well as merge and coordinate functions, potentially even form joint sub-organizations in an adhoc fashion. The development of this system will serve as a case study for the following sections of this article (beginning with Section 4).

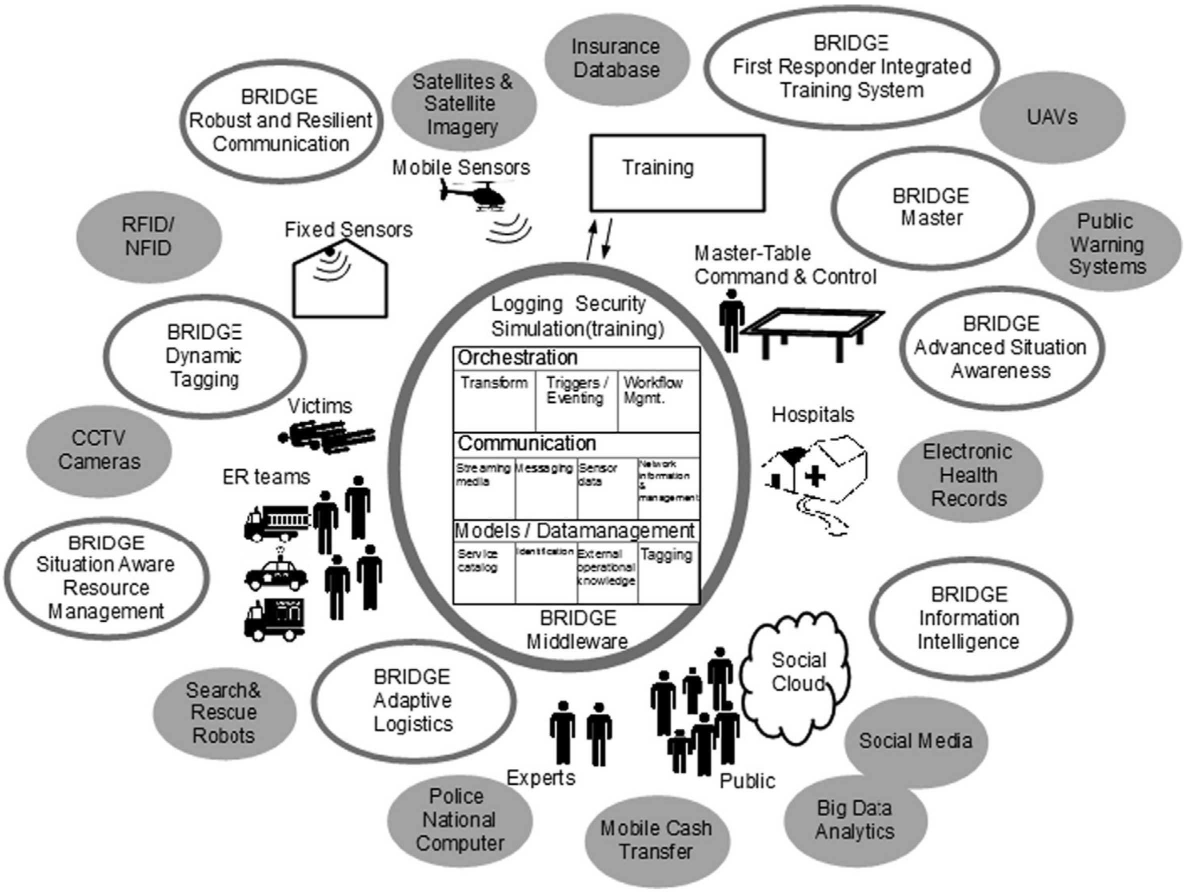

Fig. 1. BRIDGE system of systems.

Table 1

BRIDGE Systems in their final implementation.

System name	Description
Adaptive Logistics	This system uses Software-based Workflow Generation and Management (WFGM) mechanisms that support people in coordinating the efforts of human participants and artificial components in such a way that a BRIDGE system-of-system as a whole displays coherent, goal-directed behavior, realizing its goals effectively and efficiently.
Advanced Situation Awareness	This system provides real-time visual and environmental sensor information on the extent and nature of the disaster and its consequences by means of an UAV. An expert system supports exploration of such data against national and international standards, and a modeling module visualizes data and estimated developments.
Dynamic Tagging	This system provides Assistance for first responders to mark and monitor significant locations of a disaster site and create real-time situation awareness. It also supports annotation of the environment with digital information. It includes an eTriage system (i.e., tagging of victims). Data transmitted by triage armbands was displayed on tablet PCs, smartphones, and the Master.
First Responder Integrated Training System (FRITS)	This system uses BRIDGE methods and tools together with COTS (commercial off-the-shelf) technology to support training. The prototype combines a training methodology with evaluation tools, live and virtual training support through tracking movement, communications, and activities in an integrated training environment.
Information Intelligence	This system supports analysis of social media and other data from the disaster. It provides information aggregation tools based on algorithmic identification of sub-events or themes. It allows simulation of data streams for exercises, and supports collection of live data.
Robust and Resilient Communication	This system creates and ad-hoc networking infrastructure that provides networking services on an incident site, based on wireless Mesh routers. HelpBeacons allow people to use WiFi technology to place short help messages. These can be collected automatically with HelpBeacon-Seekers, which can use multi-sensory formats to notify responders of victims trapped or otherwise in need of help.
Master System	This system supports responders in drawing information together for a common operational picture and to act on this information. Geo-referenced and other information can be visualized in different ways (e.g. on a map on a table), accessed and processed on different mobile and stationary devices.
Situation Aware Resource Management	This system supports collection of information (location, activity, etc.) of, and interaction with, emergency personnel and first responders and material resources. It enables advanced coordination during large- scale multi-agency emergency response through outdoor location tracking, dissemination of information using international emergency data exchange standards (e.g. EDXL-RM), task assignment, availability monitoring, context awareness and dynamic team formation.

2.3. From emergency ethics to a socio-technical design ethics for emergency response

While there has been an extensive discussion on the technological and functional aspects of developing and maintaining distributed systems such as the BRIDGE system of systems, many ethical, legal and social implications need to be taken into account (Büscher and Wahlgren, 2015). Technologies like the ones presented above can augment responders' capabilities to carry out risk analysis, communicate and coordinate, act accountably, and gather and process information about an emergency, but they can also complicate risk analysis, reduce opportunities for face-to-face interaction, undermine existing practices of professional integrity and accountability, and contribute to information overload. A number of ethical issues arise from the amalgamation of ever more sophisticated ICT into people's imaginaries, practices and policies.

In their current use of IT, emergency responders often air on the side of caution when faced with such questions, especially in multi-agency collaboration, often choosing not to share data. Fragmentation of response through 'silo-thinking' is a common result and a challenge to ethical conduct (Cole, 2010). Paradoxically, this is, at least partially, a result of the very capability of information systems to support data sharing. They also enable others to monitor professional communications and decisions, including decisions over data sharing. In an environment where such meta-data can be treated as evidence for malpractice and attract blame and punishment, people are reluctant to take risks (Jillson, 2010; Büscher et al., 2015b)

These include questions like: Should public health agencies and other emergency response agencies have access to individual electronic medical records? How should informed consent be applied when records may be lost and the situation requires urgent decision making (Jillson, 2010)? But also 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 (Büscher et al., 2013)? How to deal with the potential change in organizational structure that such situational awareness tools might bring about (Ellebrecht et al., 2013)?

Especially in the domain of emergency management with its high stakes, where time is critical, and action has to be taken now, ethical concerns can be very challenging to explore when danger looms and the saving lives is the prime objective. It is sometimes argued that emergencies are a state of exception (Schmitt [1922], 2012; Sorell, 2003) which justifies solutions that under normal circumstances would be ethically questionable. Accordingly, there has been an ongoing ethical and political debate about what makes an incident an emergency or disaster (often defined by scale, urgency, severity) and which emergency measures are justified in which situations (Kerasidou et al., forthcoming).

The argument that ethics should be suspended to a certain extent is in holding with consequentialist ethics, which evaluates 'rightness or wrongness based exclusively on the consequences or effects of an act or acts' (Powers, 2005) and is looking for the 'overall' best outcome or 'greater good'. In emergency response, consequentialist positions translate into maxims like 'Save the Greatest Number (SGN)', even if that comes at the price of having to sacrifice the few for the many.

Both the argument of exception and the suspension of laws or normal ethics during these states, and the logic of consequentialism is highly disputed, especially It has been argued that the exception serves as a precedent, making future exceptions more likely. An argument that should make cautious especially in the field of technology, where a technology implemented only to be used in exception may prove not to be well enough trained to actually work when needed or vice versa may suggest itself for everyday use, a process known as "function creep" (Groff and Jones, 2012).

However, first of all a state of exception has to be declared, not all emergencies automatically qualify as exception, and even then, as we have already discussed, in their current use of IT, emergency responders often are reluctant to share data and some expert policing analysts argue,, that in relation to the legality of ‘criminality information sharing’ in the UK, ‘an intolerable level of uncertainty as to the issue of that legality has now been reached’ (Grace, 2013). The challenge then—beyond the question of exception—is how to engage in design that will incentivize and enable circumspect data sharing and interagency collaboration.

Engaging in this discussion, however, is related to a fundamental issue of technology design—the indeterminacy of technological futures and the question how ethical implications can be explored before they arise, or rather, how to enable them to arise and reveal themselves in an experimental design setting.

This does not only pertain to the level of design challenges, i.e. how to build experimental environments that allow for ethical exploration, but also the challenge of the organization, i.e. how to raise awareness and find a language and procedures for such design challenges in the context of an large scale interdisciplinary research and innovation projects 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.

In the following section, we will provide an overview on existing approaches of co-design with regard to ELSI, before we continue to present our own approach to the subject matter with our case study.

3. ELSI in co-design and IT regulation

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.

3.1. 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—labor 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 and 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-realization 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, emphasizing 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 and 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-realization of socio-technical futures, responding to the emergent and transformative nature of innovation (Hartswood et al., 2008). When we refer to co-design in this article, we reference these traditions, convictions and methods. Codesign 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 and 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 (Wulf et al., 2015, 2011). 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 Blomberg 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' (Friedman et al., 2013, 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 artifact 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 2008a, p. 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 1990s a 'participatory turn', saw public engagement, dialog and more participatory styles of governance become central paradigms within the science and policy worlds (Felt et al., 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 and 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'.

3.2. 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.[4] 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.

Privacy by Design is closely related to the concept of 'privacy enhancing technologies' (PET) (Information 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, p. 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 and 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 PþEIA process (Wright and Friedewald, 2013).

3.3. 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 sociotechnical 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.[5] In the context of major incidents, where emergency services, commercial utilities and telecoms 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 interest 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 dialog 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.

In the next chapter, we will outline how we approached the issue of ELSI within the context of our case study, the BRIDGE project.

4. Case study: exploring ELSI co-design in BRIDGE

Our research has been conducted in the context of BRIDGE, a large European FP7-project concerned with IT system innovation for interoperability in large-scale emergencies. This context provided the opportunity for learning about domain specific ethical issues, and more importantly, the opportunity to develop experimental methods for unfolding the ethical implications of the introduction of IT Systems in this ethically sensitive domain.

The approach which we used in BRIDGE followed an iterative, experimental research and development process that integrated ethnographic observations and insights from user engagement and co-design into specification, integration and experimental implementation of new technologies. This approach was inspired by the concept of disclosive ethics (Introna, 2007). However, rather than analysing already fully implemented systems, we were interested in disclosing ethically relevant aspects of socio-technical systems during design time.

The leading hypothesis in this approach, well in line with the literature, was that neither the actual usage of technology nor potential ethical issues can be known in advance. Rather, ethical implications become imaginable—and can be articulated and experienced—only in the coming-together of practices, stakeholders (i.e. everyone directly or indirectly affected) and socio-technical systems. 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 is not so much something to be checked (that already exists) but rather something that needs to be constructed and formulated. In this respect, we see a certain analogy with co-realization, where a new technology is designed in negotiation of technical feasibility and current practices. In other words, current ethical intuitions can be explored in the context of technological prototypes-in-use, but in the process that ensues, both technology and ethics are under construction.

This means to construct environments, where technological black-boxes can be opened, the complex effects of technology-inuse becomes observable and ethical implications related with such use can emerge so that it becomes available for the discussion by diverse publics. Drawing on the notion of "living laboratories" (Ogonowski et al., 2013), we reasoned 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 (Fig. 2).

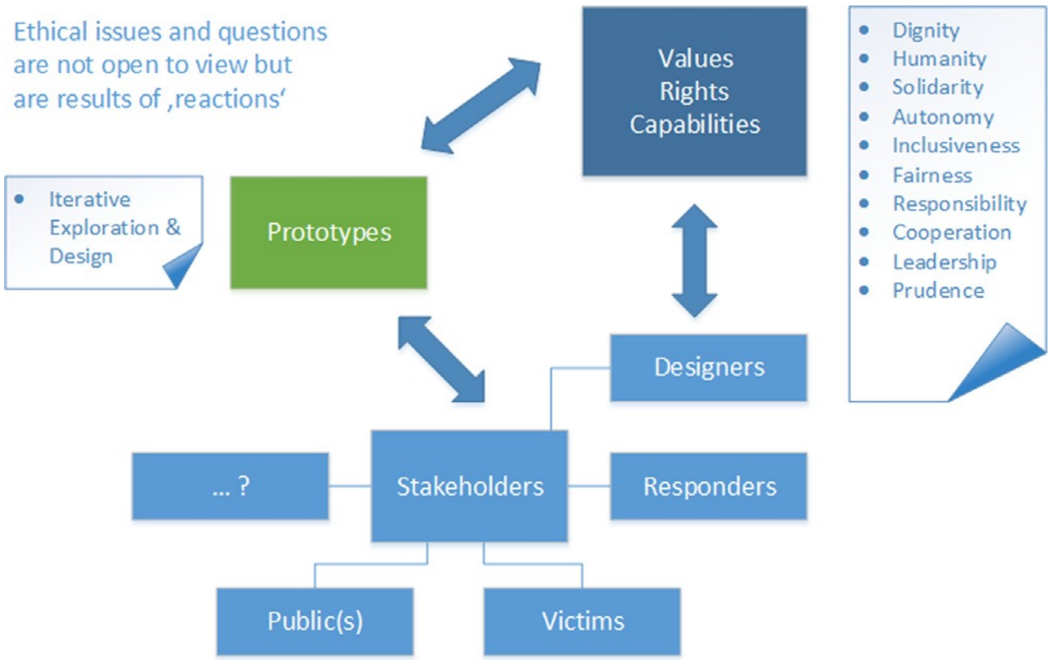

Fig. 2. An illustration of the BRIDGE approach to disclosive ethics in design-time.

For our approach 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. 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 and 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.

The implementation of the approach that we followed in 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 the following sections, 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 (Fig. 3).

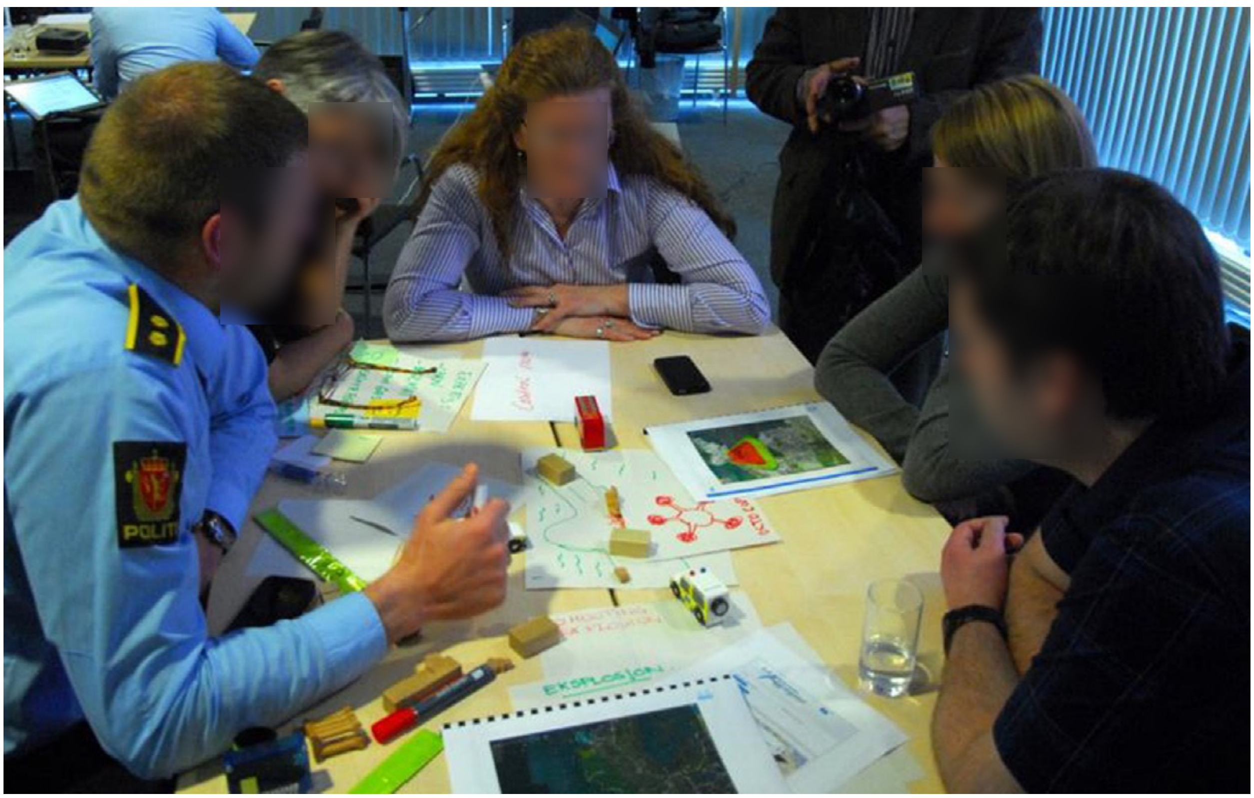

Fig. 3. Co-design workshop.

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 Section 2.3, such attempts of Privacy by Design (Langheinrich, 2001; Cavoukian, 2010) 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 microand 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 characterized 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-realization (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 organizations, 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-realization 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 did not always match this (Fig. 4).

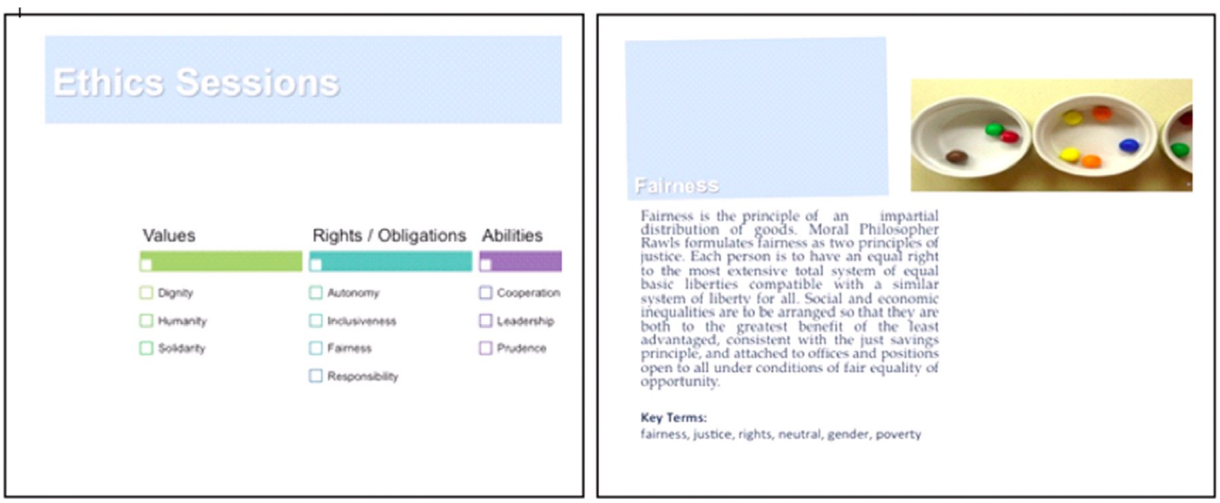

Fig. 4. PowerPoint slides used during the ethics sessions.

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 behavior 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 (Fig. 5).

Fig. 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 organizations 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 sociotechnical 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 and 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 organized three very different settings for end-user engagement with our current prototypes. In one setting, we had an exercise with local fire-fighters, testing the behavior 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 organizations 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 issueas well as publics-formations around it (Fig. 6).

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 organizational 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.

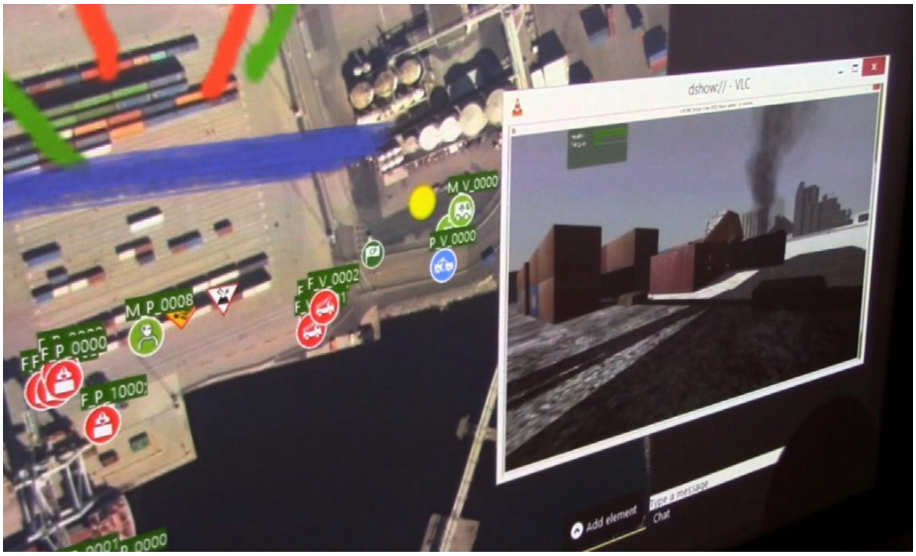

Fig. 6. BRIDGE training system.

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-realization) 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 cocomposed 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 and 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 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 trickier where the systems are distributed, in the background or involve autonomous agents, such as in the middleware and the workflow management system.

Middleware infrastructures usually 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 endeavor 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 do not 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 (for instance in the sense of a dedicated space for exploring and articulating the underlying coordination mechanisms, see Boden et al. 2014). 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 cannot 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 and 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. do not 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 emergency response alike: We are saving lives, compared to this it is 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 codesign 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 and 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 checklists 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 fulfill all the requirements and still not be useable just as it might fulfill 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 sociotechnical context) and a more specific argument of: we do not 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 et al., 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

There are many ongoing efforts to leverage the potential of advanced information and communication technologies (IT) for crisis response and management. The broader transformation in the sense of an informationalising taking place within emergency management around the world 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 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 and Wahlgren, 2015) 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. However, covering such "deeper" and "wider" implications of technology is hard due to the "opaqueness" of such systems, and often only happens either in form of policy directions (which are limited as they cannot account for emerging issues) or as assessments in hindsight.

In this paper, we have discussed the question how ELSI issues can be addressed in design-time. For doing so, we have presented and analysed our experiences with interdisciplinary and collaborative socio-technical approaches to ELSI-aware design and innovation. Our work within the BRIDGE project has provided the opportunity for deep engagement with these issues through the concrete exploration and experimentation with technologically augmented practices of emergency response. Crucially, we have seen in our study a need for 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 by design, but rather that we can help to design for.

Analysing our experiences with such concrete explorations can help us understand better how ethics is distributed between people, technology, and the economic, social and cultural environment. Our study has attempted to find ways for allowing the disclosure and exploration of emerging ethical, legal and social risks, opportunities and challenges throughout our project, in practice and through collaborative co-design processes involving project partners, designers and developers, emergency services personnel and end users.

As we have seen in our case study, ELSI co-design can be a quite distributed process with many un-known variables: Which effects will the technology show in the ecology of practices and infrastructures it gets embedded in. Who are the practitioners, and the people affected and what are possible experimental or real world settings to explore desirable and undesirable effects, and unearth ethical, social and legal implications of such technological innovations? Based on our experiences, we can summarize several “lessons learned” for doing ELSI-aware co-design.

Firstly, that such an endeavour which will inevitably have to assemble people with very different backgrounds—developers, practitioners, scientists, policy makers, members of some unspecified publics—is hard work. At the same time, awareness needs to be raised for the fact that technology is not neutral, but contributes in shaping practices and its use. Not in a deterministic way, but to the extent that both are implicated in complex ways in multi-layered effects, the matrices invite search for causes in one or the other. This is problematic when ‘the multistable nature of artifacts means that they may become used in ways never anticipated by the designers or originators’ (Introna, 2007, p. 16).

Secondly, it's not just this technological artifact, but the artifact embedded in a complex ecology of infrastructures, practices and processes, that has an effect. If we translate these considerations into crisis management, we must consider ethics across a whole network of agencies and circumstances. Unless technology is analysed as one element within a nexus of practices, misconceptions are likely. Introna and Wood argue persuasively that:

the politics of technology is more than the politics of this or that artifact. Rather these artifacts function as nodes, or links, in a dynamic socio-technical network, or collective, kept in place by a multiplicity of artifacts, agreements, alliances, conventions, translations, procedures, threats, and so forth [...] Some are stable, even irreversible; some are dynamic and fragile. Analytically we can isolate and describe these networks .... However, as we survey the landscape of networks we cannot locate, in any obvious manner, where they begin nor where they end. Indeed we cannot with any degree of certainty separate the purely social from the purely technical, cause from effect, designer from user, winners from losers, and so on (Introna and Wood, 2004, p. 179).

Thirdly, ethical values are relative and are subject to processes of change and negotiation. For such debates to happen, ethical issues have to be noticed and turn from matters of fact, that is, accepted, unnoticed, taken for granted, common-sense facts of life, into ‘matters of concern’, that is, interrogated, dissected, contested objects of critique (Latour, 2005). A challenge for an ethically circumspect approach to IT innovation in information societies therefore lies in the question of 'how to make ethical opportunities, challenges and risks (for example of innovation in IT supported multi-agency emergency response) public?' and 'how to engage and include (which?) stakeholders?' (Wynne and Felt, 2007).

The main take-away insight from our study is that to take account of these dimensions needs to be explicitly facilitated. We have argued that a variety of design and regulatory approaches implicitly address ELSI issues. Yet in order to do so systematically, it takes explication work. The task of 'making ELSI explicit' we found, is demanding and it may be advisable (we found it useful) to allow for the special role of ELSI-Co-Design facilitator, a role responsible for assembling stakeholders, translating, building and organizing environments for exchange and exploration, but most importantly sensitizing for ELSI aspects and explicating ELSI aspects that occur in the design process and, being knowledgeable in relevant ethical, legal, and social debates on technology and emergency, explicitly feeding those debates into the design process and putting the finger on the sore spots, thus encouraging and nurturing further debate, negotiation and understanding.

Our work has been driven by the desire to not only find sociotechnical 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.

Research and development projects 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, p. 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. This paper is thus meant as a first step towards an 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). Hence, following ELSI co-design means to acknowledge that there is no one size fits all approach for how to do science and innovation in more 'careful', responsible or democratic ways. 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. And, last but not least, innovation should not be seen 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 an active, explicit role in the shaping of desirable futures. 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.

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Notes

[1] See for instance the ISCRAM conference series for a discussion of related trends and approaches (http://www.iscram.org/).

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

[3] See http://www.bridgeproject.eu/en and http://www.secincore.eu.

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

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

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