Resilience and Values: Antecedents for Effective Co-design of Information Systems

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Complete Research

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Abstract

The notion of resilience is becoming an important consideration in addressing the needs of vulnerable individuals and groups in the public sector. In Information Systems development, resilience has often been treated as non-functional requirement such as scalability and little or no work is aimed at building resilience in end-users through systems development. In this paper we introduce a refinement of the value sensitive action-reflection model used in co-design, first introduced by Yoo et al, that recognises the tension between values and resilience. We report on our activities of using this approach for a project aimed at developing mobile apps for promoting better engagement between young people in conflict with the law and their case workers in the UK youth justice system. We examine the ambiguity created when designer and stakeholder prompts change their role and purpose during the co-design process and discuss the impact of this on resilience building for the end-user and the possible implications for Information Systems design processes.

Keywords: Co-design, Value-Sensitive Design, Resilience.

1 Introduction

Today's Information Systems are driven by the need for ubiquitous availability in a hyper-connected world. Moreover, there is a new and possibly unsustainable demand on the need to preserve key human (moral) values such as as privacy, security and autonomy whose loss may have a detrimental effect of the resilience of end-users. So it becomes incumbent on designers of systems to ensure that stakeholders can make their representation of preservation of values to designers as part of the design process. However, the trick of involving users and their values in the design process is manifestly difficult and the nuances of how values of security / privacy and autonomy become incorporated into the design process remains an ongoing challenge. When end-users are those from marginalised or largely excluded communities then these challenges are particularly difficult.

Resilience has its origins in materials sciences and eco-systems but its discussion is now prevalent in fields such as psychology, security and the social sciences. Against the many notions of resilience, a working definition of resilience from the OECD that should suffice is: '*[Resilience is] the ability to cope with changes in capacity, effectiveness or legitimacy. These changes can be driven by shocks ... or through long-term erosions (or increases) in capacity, effectiveness or legitimacy*'(OECD, 2008).

In Information Systems (IS) research, resilience has often been viewed through the lens of non-functional requirements and examined in terms of scalability, reliability, maintainability and availability. What has not been easily understood or investigated in the context of IS research at least, is how resilience is manifested or could be engendered in end-users as a result of an intervention such as the introduction of a system. Indeed, the many variants of IS evaluation models such as the Technology Acceptance

Model (Davis, 1993) and Unified Theory of User Acceptance of Technology (Venkatesh et al., 2003) do not include resilience as a determining factor and therefore resilience is not assumed to contribute to acceptance of systems. Given the very limited literature linking resilience of end-users and Information Systems one may conjecture that the relationship lacks substance. We propose that a study of *values* may help develop a better understanding of this relationship.

Unlike resilience, the notion of *value* (beyond a monetary sense) has been investigated in discussions of how values could be integrated into the software engineering process in the seminal article by Suchman (1997) and then subsequently by Friedman and her colleagues on Value Sensitive Design (Friedman, 1996).

In this paper we claim that value is intrinsically related to resilience by proposing that addressing value based concerns in IS systems design can encourage and engender resilience in the end-users of systems. Consider the following two examples.

Example_1: Sensor based systems are deployed to help patients with Alzheimer's Disease operate approximately normal lives with a sense of autonomy (an intrinsic value important to the patient). The system provides resilience to the patient in their daily life. However, a potential side effect of the system arising from the personal data collected might indicate to welfare providers that other support or resources to the patient can be reduced. Then the patient might not wish to participate in the use of this system with consequence that the patient would lose resilience as a result of other values being compromised.

Example_2: Google recently published a statement that email users should not have *any* expectation of privacy (`http://bit.ly/1nVj4di`). Value sensitive scenarios relating to email use could have better prepared email users to not expect any entitlement of privacy so when this became news the individual email user was better prepared, i.e. more resilient and perhaps able to switch to alternate providers.

Thus values are an antecedent for end-user resilience. To support this claim we make the following contributions: We contribute a critique of the intrinsic relationship between values and resilience by first drawing upon extant literature and then present a synthesised information model of this relationship. Secondly we evaluate that relationship within the context of an ongoing research study aimed at developing mobile apps for promoting better engagement between young people in conflict with the law[1] and their case workers in the UK youth justice system. Implications for the design of socio-technical Information Systems are discussed.

2   Resilience and Values

The concept of resilience is found across many disciplines including material sciences, ecology and has been broadened to include psychology and also Information Systems design. In material sciences, resilience is a physical property of a material to bounce back to its normal shape after some deformation event. Ecologists have used resilience to refer to the ability of ecosystems to absorb and respond to disturbance (Holling, 1973). Psychologists use definitions that encompass two inter-dependent parts adaptive functioning and exposure to risk or adversity. Moreover, resilience has been characterised as the positive capacity of individuals to cope with stress and catastrophic events and their level of resistance to future negative events (Erol, Sauser, and Mansouri, 2010). This definition is well suited to current contexts where state delivered services have seen a shift from a deficits-based approach to one that highlights strengths and resources that may enable adaptive functioning and positive outcomes (Hunter, 2012). Greenberg in writing about preventative interventions notes that resilience depends upon the existence of broadly three types of protective factors including: the characteristics of the individual (e.g. temperamental qualities, cognitive ability), the quality of the individual's relationships and "broader ecological factors

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[1]   In this paper, we will use the term "young people" to refer to those who are in conflict with law.

such as...safe neighbourhoods and regulatory activities" (Greenberg, 2006). The case study described in later sections aims to engender some of these protective factors. The psychologist's view of resilience is made further relevant as it offers additional elaborations that resilience is not a "general quality" representing an individual's trait and that research needs to focus on "the processes underlying individual differences in response to environmental hazards, rather than resilience as an abstract entity" (Rutter, 2006). Interaction is key in a process oriented understanding of resilience. In support for this approach, Kolar (2011) states: "In focusing on the interactive and variable nature of risk and protective factors, which themselves range from micro (individual) to macro (societal) levels, a process-based understanding facilitates the evaluation of resilience as a shared responsibility between individuals, their families, and the formal social system rather than as an individual burden " (Kolar, 2011, p425). Researchers have also noted how a person can demonstrate resilience in one domain but not another, or at one point in time but not another (Rutter, 2006; Wright, Masten, and Narayan, 2013). A consolidated view emerges that this lack of consistency or permanency of resilience over time or aspect of development, even within individuals, is evidence against conceptualising resilience as a single quality or trait (Rutter, 2006; Ungar, 2013; Wright, Masten, and Narayan, 2013). If a person possesses resilience - the ability to react and bounce back from adversity then it is helpful to view resilience as both an engendering process and a property that arises from the process. Hence, it is suggested that systems can help with engendering process.

Opportunities for engendering resilience through the use of technology are becoming more widespread particularly in the area of emergency and disaster management and there are numerous examples referring to the use of social media. For example, Twitter has been used to harness communities together for responding to disaster emergencies (Gao, Barbier, and Goolsby, 2011; Hughes and Palen, 2009; Shklovski, Palen, and Sutton, 2008). Of greater relevance is the study by Mark, Al-Ani, and Semaan (2009) because of the inference of a relationship between resilience and values. Mark et al. reported on how technology was adopted and used by citizens to be resilient during wartime. They identified properties of resilience: reconfiguring social networks, redundancy, proactive practices and repairing trust in information. The latter is very much a core moral value.

A candidate theory to help explain the relationship between values as an antecedent to resilience is Ashby's Law of Requisite Variety (Ashby, 1958). The law states: The larger the variety of actions available to a control system, the larger the variety of perturbations it is able to compensate. There are some practical implications for this in that the potential for the variety of perturbations is unlimited but variety in the control mechanisms may not be of the same order of magnitude. Gallopin although, mostly concerned with conceptual linkages between vulnerability, resilience and adaptive capacity noted that resilience (vulnerability) referred to the capacity of a system to recover from disturbances. Adaptive capacity in such a context requires that a system has an ability to evolve (minimally to present a different state) in order to enhance the range of variability (Gallopin, 2006).

Fiksel (2003) identifies four factors that may contribute to resilience:

- diversity - the existence of multiple forms;
- efficiency - performance with modest resources;
- adaptability - flexibility to change in response to new pressures and
- cohesion - the existence of unifying relationships between system variables.

The adaptive capacity of a system is therefore the variety of controls available to manage perturbations of system states. Drilling down, values have the potential to become the variables used by the controls. One observation on the literature concerning resilience is the absence of the use of Ashby's law to account for resilience. In the examples presented above, Twitter exhibits the adaptive capacity necessary for variety because it can operate using text messaging for broadcast purposes when there is no wider internet capability. Similarly, following Fiksel's analysis of key factors, the use of text message presents sufficient performance with modest resources. One issue with the law of requisite variety in this context, is how different varieties may conflict and produce outcomes that are undesirable. Later in this paper, we will

outline how we address these issues of value conflicts. In the case study described later, a classical conflict is autonomy versus privacy.

An examination of how *values* have been integrated with systems design reveals that early efforts at computerisation are characterised by an absence of any effort to address the notion of *value* beyond the narrow sense of the economic worth of an object. Further, computerisation has not accommodated the dependencies on the interests and desires of human beings at large (Friedman, Kahn Jr, and Borning, 2006). Friedman thus defines value as "what a person or group of people consider important in life". While the framing of such notions of value has ancient origins in Plato, Friedman identifies certain values that are particularly pertinent to information systems development [ibid]. Such values include: ownership and property; privacy, freedom from bias, universal usability, trust, autonomy, informed consent, identity and others. (See (Friedman, Kahn Jr, and Borning, 2006) for a full list.

Values have been mostly explored in the context of Participatory Design (PD) (e.g. (Bjerknes et al., 1987), (Mumford, 1983) and Cooperative Design (Greenbaum and Kyng, 1991) or more latterly as "Co-Design". Co-design involves potential (un-trained) end users working jointly with researchers and designers using tools provided to jointly create artefacts that lead directly to the end product (Sanders, 2000) and as Yoo et al. (Yoo et al., 2013) state has "become a dominant user study methodology in the fields of product design, service design, interaction design and HCI (Muller, 2003)". Values have also manifested themselves as first order concepts in methods such as Contextual Design (CD) (Beyer and Holtzblatt, 1998). CD provides techniques for analysing cultural or political forces in the organisation that may impinge on roles to prevent or modify how work is done. Limitations on how values are managed within PD based approaches include issues that may arise as not all users can participate in decision making. There may even by conflicting values and preferences. In product development contexts, user involvement may be transitory and preferences and value considerations may not be evident in short discussions (Kujala and Väänänen-Vainio-Mattila, 2009).

Arising from these challenges, Value-sensitive design (VSD) emerged to integrate moral values (and more broadly ethics) with the design of systems to address the issue raised by Wiener (cited in (Friedman, Kahn Jr, and Borning, 2006)) when he argued that we should be the masters of technology, not worshippers (Wiener, 1985). A key premise of VSD is that it seeks to design technology that accounts for human values throughout the design process (over and beyond the identification of functionality and visual appearance) of systems. Thus VSD has a stated goal that there should be freedom from bias in systems. That is: computer systems should not systematically and unfairly discriminate against certain individuals or groups of individuals in favour of others (Friedman and Nissenbaum, 1996). VSD has developed both methods and theory that incorporate particular values into technologies through conceptual, empirical, and technical investigations. A conceptual investigation of value-sensitive design involves questions about the stakeholders being affected by the design; the values being implicated; and to what extent the moral values have weight compared to non-moral values. An empirical investigation would take into account the human context and be used to measure the success of certain designs. A technical investigation focuses on how existing technological properties and mechanisms support or hinder human values. The focus is on the technology itself. Other cornerstones of VSD recognises two classes of stakeholders: direct and indirect. Direct stakeholders refer to parties—individuals or organisations—who interact directly with the computer system or its output. Indirect stakeholders refer to all other parties who are affected by the use of the system. VSD is also intended as an interactional theory, that is, values are neither embedded in the technology nor are they transmitted by external social forces. Instead, features that are designed may support certain values and hinder others. For example, the Microsoft Outlook calendar sharing feature supports an individual's accountability to an organisation but renders privacy difficult.

VSD has further evolved to recognise specific value based inputs from users in a co-design space using a conceptual framework of designer prompts, stakeholder prompts co-operating and undergoing a process of reflection (Schön, 1983) to arrive at a shared design (Yoo et al., 2013). A key aspect of the approach is the incorporation of reflection into the design process and to provide a means for incorporating empirical data on values into the co-design space. Related to this is a specific toolkit of envisioning cards

(`http://www.envisioningcards.com`) that address some of the criticisms that have been raised with VSD such as the degree of positivism implicit in the approach; lack of incorporation of empirical data of values and the identification of stakeholders (Manders-Huits, 2011). In general, the study of values in the design context has focussed on collective (or shared) values rather than personalised values such as affection, ambition, capability and maturity. These types of values are often called traits (Bhamra, Dani, and Burnard, 2011).

Our claim is that there is an intrinsic link between accounting for values and engendering resilience in target end-user community. Currently, literature that links values with resilience as conflicting non-functional goals is limited. However we note that Cunningham reported on a study exploring the resilience of value based contracts of employees in voluntary organisations when faced with interference from state funding bodies. The results indicated that value-laden contracts exhibit some resilience but noted implications for HR practitioners (Cunningham, 2010).

Figure 1 aims to capture the essence of the conceptual requirements using IDEF0 notation. Engendering resilience in an individual or group is about providing them with "tools" that enable the individual or group to adapt to some risk and adversity to enable continuing functioning.
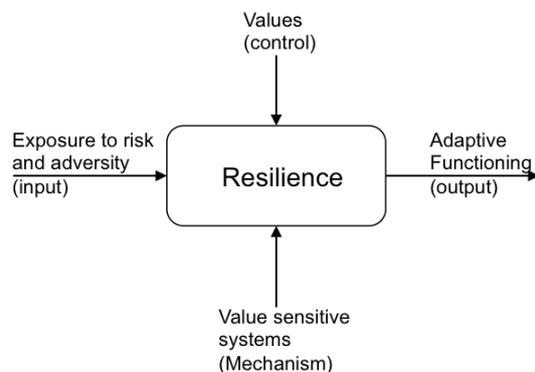

Figure 1.   Resilience and Values

Our proposal is that when designers are engaged with the act of designing socio-technical systems that are aimed at developing traits of resilience in end-users then such aims need to consider the implicit relationship with corresponding values. Values, we contend, can have a controlling effect on whether resilience will be enabled. Our two earlier examples of Google Mail privacy concerns and the developments of sensor based systems provide an illustration of the controlling effect of values. By addressing value sensitive concerns in the design process, resilience as an outcome is more likely. To support this claim we present a consolidated notion of resilience integrated with values drawn from two recent systematic literature reviews by Windle (2011) and Bhamra, Dani, and Burnard (2011). Currently there are no formal or semi-formal models and their associated processes for integrating values and resilience in this way. Treating such an integration as a model based language design activity has several benefits. Firstly, we can utilise suitable meta languages for defining an abstract syntax and associated constraints. Secondly the use of a meta model for the abstract syntax provides a ready route for tooling in platforms such as MetaEdit+ (MetaCase, 2015). A final benefit of using such modelling techniques is that we can readily construct approximate theories using the approach taken by Sjoberg et al. (2008). Some early progress where we just focussed on value sensitive concerns, into this avenue has been made (Barn and Barn, 2015). Our consolidated model is documented as a UML (Unified Modelling Language) conceptual model (Rumbaugh, Jacobson, and Booch, 2004). We limit the semantics of this model to be a collection of traces representing a sequence of changes in resilience of an entity. Each set of traces is described by a system state change represented by object diagram that are instances of the semantic model. The semantic model comprises objects and slots that contain values. Additionally there are well-formed rules that determine

how an instance model is deemed to be correct with respect to the conceptual model.
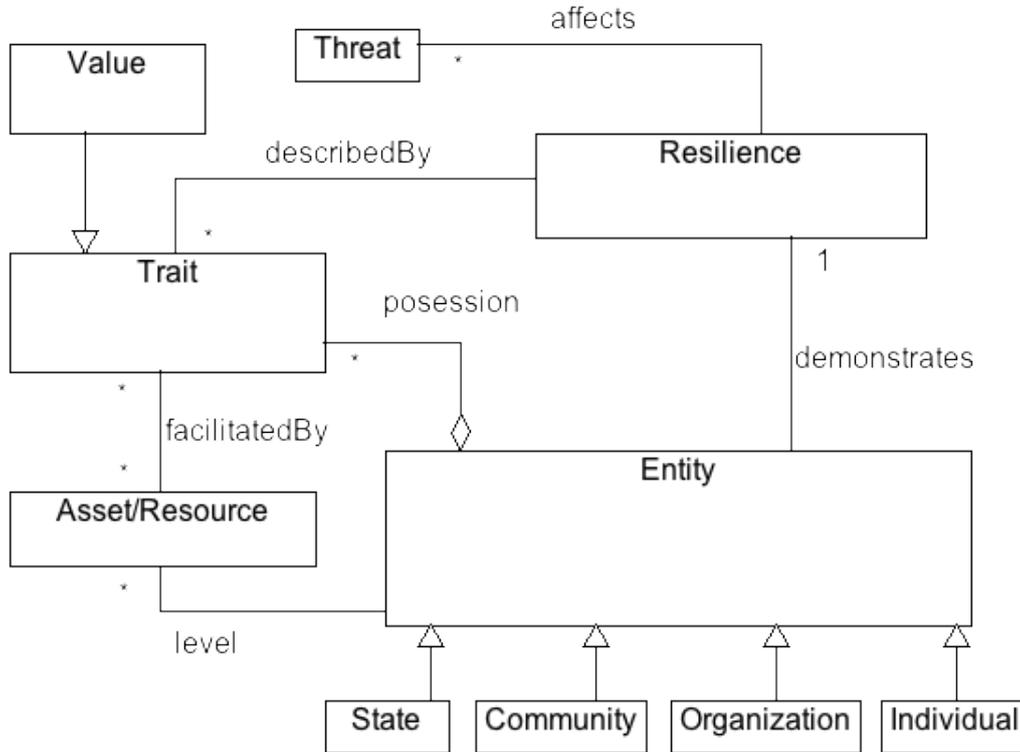

Figure 2.   Consolidated Conceptual Model of Resilience

In this model, *Resilience* is a property that an *Entity* has that allows it to respond to adversity or threats from the environment. An Entity can be either an individual person, an organisation, a community or a government state (reported by both Bhamra, Dani, and Burnard (2011) and Windle (2011)). An entity in order to exhibit resilience, must possess *Traits* such as flexibility, motivation, perseverance and optimism (from Bhamra, Dani, and Burnard (2011)). Windle reports on the consensus within research for the role of protective factors also called *Assets* or *Resources*. Greenberg also reports on protective factors. These are "recognised as crucial in achieving resilience.." and facilitate the competence or capacity of an entity to adapt to meet a threat (Windle, 2011). Assets function across individual and societal concerns. In this model, we propose that *Value* is a type of trait that an entity may also possess and it too is supported by assets and plays a role in engendering resilience.

Importantly, this model provides a semi-formal description of relationships between concepts that papers such as that by Windle and those cited by Windle have not done to date.We now evaluate this proposal in the context of our on-going research study by first presenting an overview of how we embed values into the co-design process.

3   Value Sensitive Action Reflection Model

The background section provided a more detailed discussion of the general features of underpinning the Value Sensitive Action Reflection Model. Here we provide an overview of the framework. Yoo et al.

(2013) describe their experiences of the use of a value sensitive approach to co-design. Although they accept that co-design focusses on end-user needs and desires, the process is inherently technology-centric hence their model brings forward values into the co-design process in the spirit of Schon's reflection on action (Schön, 1983).

In their model, the traditional co-design core blends methods from value-sensitive design to structure the co-design engagement with inputs from stakeholders and considerations of values. The co-design process may be initiated by free-form thinking, but their key innovation is in the introduction of two types of structured interventions. Designer prompts entail materials that originate from expert designers and may comprise personas, scenarios or the use of envisioning cards. Stakeholder prompts originate from the end-users and may utilise value based scenarios addressing concerns such as unintended uses of the system; changes of the use of the system over time and so on. Values will be, typically, those derived from the list suggested by Friedman in (Friedman, Kahn Jr, and Borning, 2006). The reflection element of the model provides a way of representing how prompts may be generated by either a stakeholder or a designer as a result of joint participation in the co-design space. The reflection relationships also provide showing traces through a co-design process. The example shown in figure 4 is one such case. A possible limitation of this framework is that it is difficult to locate a well-defined theoretical basis, despite this, it remains a useful entry point for evaluating conflicts in the design process.
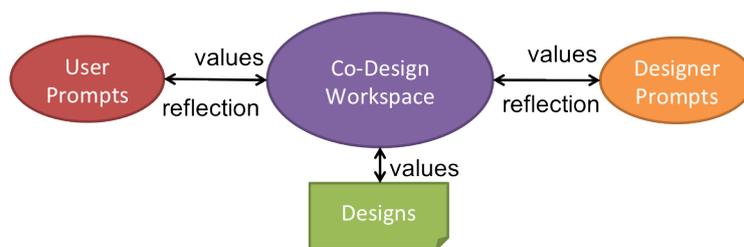

Figure 3.   Value Sensitive Action Reflection Model

4   Case Study Commentary on Resilience and Values

The socio-technical context for this research concerns young people in the UK Youth Justice system. Research suggests that engagement with young offenders to help promote social inclusion and prevent re-offending remain key challenges for public policy and youth justice service providers (Smith, Goldson, and Muncie, 2006). Yet currently, digital tools that could engender closer engagement and encourage co-creation between Youth Offending Team case workers and young people are not available. There are no tools that utilise web 2.0 and mobile apps that specifically support young people in managing their personal situation and creating resilience within the youth justice system. Given that there, annually, over 25,000 first time young people in conflict with the law and arounf 9,000 YOT workers in the UK, the need is significant (MoJ, 2014). Instead, within the youth justice system, the use of technology has largely focused on surveillance and supporting organisational structures and processes (Nellis, 2004). Firstly, technology has been applied in managing recidivism by "tagging" and the use of location-aware GPS technology for tracking young offenders. Secondly it is being used in managing and optimising information needs of various stakeholders by the development of a range of information systems (IS) for sharing and integrating data about young people. Neither of these uses is aimed at using technology for addressing the expressed needs and concerns of excluded groups and neither is focused on a positive and direct engagement with young offenders.

4.1 Approach Taken

Research context

The MAYOT (Mobile Applications for Youth Offending Teams) project developed a personalised mobile app for use by young people and their case workers in youth offending teams. The app provides relevant, timely information to a young person as well as features such as ease of access to their case history, relevant contacts such as professional networks, peer networks and their family networks. Through regular interaction with the app and the case worker, it is hypothesised that young people will engage in a positive manner with their situation and so ideally improve their life chances. The app and the server side software has been deployed at two of the research sites and is currently being used by case workers and their young people.

Participants

Our participants were drawn from three Youth Offending Services (YOS) in the UK, covering a mixture of inner-city, urban and rural areas. A total of six co-design workshops were carried out with the first workshop serving as a pilot workshop. There were a total of 38 participants including caseworkers and 14 young people. Questionnaires were used as additional data collection mechanisms and a total of 65 youth justice professionals and young people contributed to that aspect. In contrast to the study reported by Yoo et al (Yoo et al., 2013), we did not seek to run separate sessions for each of the stakeholder types at all times.

Procedures

Members of the project team included experienced developers, software engineering specialists, sociologists and criminologists representing a highly skilled multi-disciplinary team. The team also had prior experience in developing mobile applications and using participatory design (Barn, Oussena, and Barn, 2009). This past experience had raised specific issues with "users as designers", hence we chose to "seed" the co-design process with designer prompts with the prompts serving to trigger a cycle of reflection-on-action that refined the co-design space and the designed artefact. The reflective process also triggered stakeholder prompts, which were formally collected and later used for reflection-on-action in subsequent workshops. The seed designer prompts were based on literature reviews of the use of technology in youth justice settings originally reported in (Barn and Barn, 2010).

Of particular importance is our use of one of the case study organisations and some explanation is necessary. Our third YOS came to the study after it was under way and after several of the co-design workshops had already been conducted. Therefore, we chose to utilise the "Urban" YOT as an independent expert evaluator of the design outcomes from the two other contributing organisations. This gave us several advantages. Firstly it provides us with an in-built evaluation instrument as well as providing us with the usual co-design benefits of reflective practice. Our workshop with this organisation was therefore organised slightly differently in order for us to deploy an adopted user acceptance instrument derived from the UTAUT model.

4.2 Commentary

The co-design activities in the various workshops yielded a rich set of data including design and specification of features/functions of the MAYOT app. However, in this paper we are concerned primarily with how a value sensitive action-reflection model influences the co-design process with respect to the resilience building traits we wanted to encourage with our target end-users. Thus, we limit our reporting to the impact on the same and use one of the derived functions/features to illustrate the identified influences. However for completeness we summarise the key features / prompts in Table 1. Greenberg noted three types of protective factors including: the characteristics of the individual (e.g. temperamental

qualities, cognitive ability), the quality of the individual's relationships and "broader ecological factors such as...safe neighbourhoods and regulatory activities" (Greenberg, 2006). We use these factors and associate "controlling" values.

Inspection of Table 1 indicates one feature - "Exclusion Zone" whose status is still under reflection. We use this feature to illustrate the tension of incorporating value sensitive issues into the design process and the implications on building resilience in end-users. The tensions exist at several levels, between stakeholders and between stakeholders and designers as well as evolving over the lifetime of the design process.

Feature Description	Originating Type	Resilience protective factor	Value	Status
Text based Reminders Mechanism to automate SMS based reminders to the young person and their close relatives.	Designer	Individual relationships / Regulatory activities	None	Accepted
Activities such as photo-blogging; daily diaries.	Designer	Regulatory activities	Privacy (in-appropriate use of pho-tographs)	Likely Acceptance
Identified Goals & Objectives/ Intervention Plan Info	Designer	Regulatory activities	Informed Consent	Accepted
Exclusion Zone	Stakeholder (Case Worker)	Regulatory activities / Safe neighbourhoods	Privacy	Accepted after Moderation
Curfew Alert	Stakeholder (Case Worker)	Regulatory activities / Safe neighbourhoods	Privacy	Accepted after Moderation
Activity Meter Progress of Actions that the young person is planning to do in agreement with case worker.	Designer	Regulatory activities	Autonomy	Accepted
Asset Info (the presentation of summary information about the young person)	Designer	Regulatory activities	Informed Consent / Privacy	Rejected

Table 1.   Features / Prompts

Prompts: Types, Generation, Roles and ascribing Values

The Value Sensitive Action-Reflection Model described by Yoo et al. presents a neat dichotomy of designer prompts and stakeholder prompts. In a reflection based model how can such a dichotomy be maintained? In particular, if action-reflection takes places over multiple workshops the blurring between types (designer versus stakeholder) is inevitable. We illustrate this by example as follows: A stakeholder (case worker), in response to a designer prompt for information provision for young people, on the phone via the MAYOT App, offered the following stakeholder comment:

CASE WORKER 1: *"maybe bespoke… some young people are prohibited from going into certain areas so maybe their phone could vibrate if they are getting close to that area".*

Currently, exclusion zones are presented to young people by their case workers using printed maps with the areas that are prohibited marked on the printed map.

CASE WORKER 1: *"you're pulling off maps and trying to show them where, and its quite cumbersome."*

The limitations imposed by existing approaches are further exacerbated by delay in being informed about any breaches. Case workers only hear about a breach after the event so the damage to the young person's current order has already happened.

CASE WORKER 2: *"….I think exclusion zones are one where, I think police should really be monitoring or, but, we only find out if they've breached it if they get arrested in that area. So it is a difficult one to monitor."*
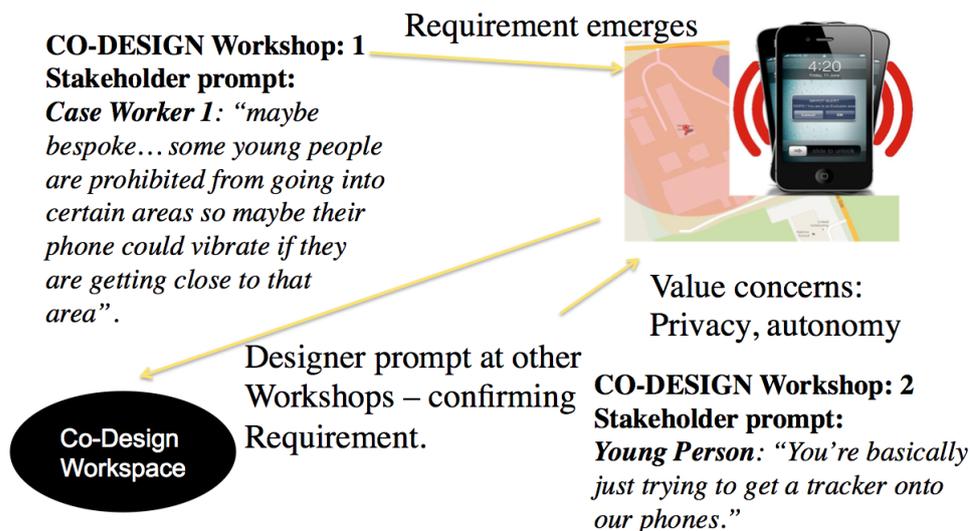

Figure 4.   Exclusion Alert: Designer Prompt

Further discussion in the workshops established that case workers viewed "nudging" young people through the use of phone alerts as an emerging feature/function of the MAYOT App in regard to the exclusion order scenario. Inputs from the co-design workshop with the case workers were then used to take this stakeholder sourced prompt to prepare a mockup of the functions for supporting "Exclusion Zone" (See figure 3). This prompt was then used as input as a designer prompt to co-design workshops with the young people. Exclusion Zone was now a designer prompt having originated as stakeholder prompt. At this point, resilience factors being addressed by the design feature aimed to provide regulatory activities as well as addressing safe neighbourhood requirements.

Continued reflection on the Exclusion Zone in the later workshops with young people created a strong reaction and further scenarios were generated but this time reflecting value sensitive concerns such as fear of being constantly monitored from different stakeholders.

GIRL 2: *"yeah. If you've got a shitty little YOS app on your phone, yeah, and they're gonna do that thing on there, they know where you are, like"* (interruption)

BOY 1: *"you're basically just trying to get a tracker onto our phones."* (girl agrees but others disagree) *"I ain't that stupid, this is just a big cover up for a tracker."*

The dialogues shown neatly illustrate the real complexity of prompts and their use in the value sensitive action reflection model rather than the relative simple dichotomy presented by Yoo et al. Firstly, the prompts acquire roles of designer or stakeholder depending upon the workshop where they were generated. Secondly, the action-reflection triggers a changing of the type of prompt. Further, not all stakeholder prompts necessarily have value, or the values themselves may be conflictual with each other. Thus we see a prompt that originated from a stakeholder, was presented as a designer prompt, and then reflected on as a stakeholder prompt and then subsequently acquiring value sensitive features.

As we noted earlier, our third case study organisation has a specific role as an informed evaluator and provided us with a relatively independent view. Reflection from the workshop with that organisation provided further insights and again evidence of the conflict between values and resilience. One worker believes strongly that the use of the Exclusion Zone provides an opportunity to have a conversation with the young person to further emphasise the importance of not being breached by going into a prohibited area and so help the process of engendering resilience:

CASE WORKER 3: *"...All this is to remind them look you're I'm not supposed to be here. The idea is a prompt. Look, I don't have to be here. Or if there's a legitimate reason. But you can at least have the conversation. But if people don't want it, I just think its quite useful?"*

Other case workers however raise further value-based issues around the ethical concerns of a case worker being aware of a young person entering a prohibited zone and not reporting it.

CASE WORKER 4: *"...but the difficulty is you can't just have that conversation if they're on bail because one strike and they're out. So if we have information that they've breached their exclusion zone, we have to pass that over to the police."*

Responses that raise the spectre of surveillance may possibly be the result of influence from current uses of technology within the youth justice system, for example, in the use of tagging systems (Nellis, 2004).

One of the outcomes from this evaluation workshop suggest that if a stated goal of an intended system is to develop or engender some concept of resilience in end-users (i.e. not the system itself) then the importance of aligning resilience with value sensitive properties can influence the acceptance of a feature in the system. Further discussions at workshops with the evaluation case study YOS suggested design options that would enable acceptance of this requirement by returning autonomy / control back to the young person. Figure 5 illustrate options that the young person can select in deciding to participate in the Exclusion Zone design feature.

5 Concluding Remarks: Implications for IS Design

Existing research evidence indicates that resilience is increasingly becoming an important and alternative response to provision of services in the state sector. Our aim was to develop a mobile app, for use by young people and case workers that aimed to engender positive engagement and resilience in young people involved with the youth offending service. We set out to use a co-design process that we hoped would engage with young people and their case workers. The numbers involved and the quality of the inputs indicate that such participation with a particularly difficult to engage client group, was largely successful. The requirements or features that utilised the connectivity of smart phones addressed resilience protective factors. What we did not anticipate and was revealed by the co-design workshops and evaluations was the tension between emergent values could influence acceptance of features aimed at building resilience. Although we recognise that there are risks to some of our analyses given the limitations of case study based research, we tried to mitigate these risks by including other research instruments such as survey questionnaires and in-depth interviews to help us triangulate our findings. We consider that the tension between value sensitive concerns and resilience has implications for IS design. In particular, value concerns
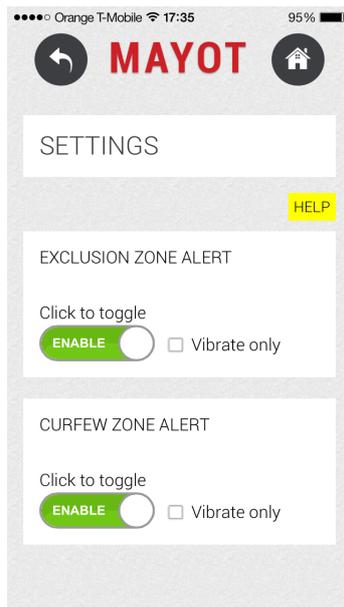
Figure 5.   Autonomy over the Exclusion Zone

such as privacy and security are key factors. We have began some initial experiments in developing tools using Baysian Networks to provide early evaluation of such concerns (Barn, Barn, and Primiero, 2015).

Resilience in Information Systems remains mostly a non-functional requirements viewpoint and takes an engineering perspective. Hence the resilience of system is often discussed in terms of up-time and performance needs. That remains an important dimension. Contrastingly, in socio-technical systems where the aim of a system is to provide some type of support to individuals or groups such as vital information to educate, empower and build resilience in the end-user, understanding resilience remains mostly in the preserve of participatory design approaches. Modelling resilience attributes of end-users is non-existent.

The role of socio-technical systems in engendering resilience in end-users has not been explored. User acceptance and technology evaluation tools such as the UTAUT model should also include measures for exploring the role of resilience and values in acceptance of technology. We see this as one of the future directions of our current research. Our initial thoughts on this suggest that operationalisation of resilience and value concepts through the use of additional research instruments will be required. The conceptual model presented in figure 2 could be a useful guide in the development of such instruments. However, much of qualitative data (through the interviews) suggests that models such as UTAUT may require a qualitative dimension.

Similarly, as we have noted in this paper, socio-technical systems raise questions of values. Moreover, value concerns are dynamic in nature and vary with context and stakeholder throughout the lifecycle of the design process and beyond. Design processes, particularly those that progress into implementation require a more nuanced understanding of how values can be modelled in preparation for and during implementation. Fundamentally, value as a first order concept remains absent in downstream software engineering processes yet the building blocks such as user centered design and co-design generate the necessary inputs. One implication of this suggests that issues of ethics and governance become harder because of the lack of traceability. Possible reasons for the absence of value concepts in design and implementation of systems may attributed to the lack of appropriate modelling languages that can bridge user and technical domains. Thus there is an ensuing research agenda that should explore languages and tools for values and resilience. A second response to this is related to goals. (Moral) values have some similarity to goals in that, attaining a particular moral value is attaining a goal. Hence it may be tempting to consider extending existing goal meta models such as that from KAOS (Dardenne, Van Lamsweerde,

and Fickas, 1993) and i* (Yu, 1997) to include concepts that we have identified in this paper. Such models provide provide abstractions for reasoning about goal within an organisational and information systems context.We recognise that is an appropriate and viable alternative but suggest that the relationship between socio-technical systems design and software implementation is significant and the route that we have taken (namely: participatory design->value-sensitive design->language design) is more relevant than that taken by Goal oriented requirements engineering based approaches for the class of socio-technical system we have produced.

Finally, as we have observed in the case study described in this paper, value-sensitive concerns can create a limiting constraint on feature acceptance of systems. Finding ways to reflect this tension in design processes is becoming increasingly important.

Acknowledgements

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