Using Argumentation to Structure E-Participation in Policy Making

Trevor Bench-Capon[1(✉)], Katie Atkinson[1], and Adam Wyner[2]

[1] Department of Computer Science, University of Liverpool, Liverpool, UK
tbc@liverpool.ac.uk
[2] Department of Computing Science, University of Aberdeen, Aberdeen, UK

Abstract. Tools for e-participation are becoming increasingly important. In this paper we argue that existing tools exhibit a number of limitations, and that these can be addressed by basing tools on developments in the field of computational argumentation. After discussing the limitations, we present an argumentation scheme which can be used to justify policy proposals, and a way of modelling the domain so that arguments using this scheme and attacks upon them can be automatically generated. We then present two prototype tools: one to present justifications and receive criticism, and the other to elicit justifications of user-proposed policies and critique them. We use a running example of a genuine policy debate to illustrate the various aspects.

Keywords: E-participation · Argumentation · Dialogues · Deliberation · Values · Policy making

1 Introduction

An important feature of democracies is that citizens can engage their governments in dialogues about policies. Traditionally this was done by writing letters: government departments employed a large number of people whose main function was to reply to these letters on behalf on the Ministers to whom the letters were addressed[1]. Although a large number of letters concerned the particular individual circumstances of the writer, others were directed towards general policy matters. Such letters tended to fall into one of three types: some were in pursuit of information and sought a justification of some policy or action; some (probably the most common) objected to all or some aspects of a policy; a third type made policy proposals of their own. The policies we have in mind have a very broad range, running from particular local issues with a small impact to issues of national importance which potentially impact on all citizens. In this introduction we will characterise each of the three different types of engagement

[1] The first author worked as a Civil Servant for the UK Department of Health and Social Security in the late seventies, and part of his duties was replying to such correspondence.

A. Hameurlain et al. (Eds.): TLDKS XVIII, LNCS 8980, pp. 1–29, 2015.
DOI: 10.1007/978-3-662-46485-4_1

and illustrate them with reference to a simple motivating example concerning a proposal by a local council to close a community library. In subsequent sections we will use the introduction of cameras by a national government to detect motorists who are exceeding the speed limits as a running example which we will model and discuss in detail.

For the first type of letter described above, the reply need only state a justification, which could be a stock reply: once a justification has been developed it can be sent in response to all such inquiries. Relating this to our example scenario, when the proposal to close the library is announced people may seek information about the number of users and trends in usage over a time period, as well as information about the running costs, both of which are likely to form part of the justification for the proposed closure. The response is also likely give reasons for closure in terms of usage or budget, or some other motivation.

For the second type of letter, a justification is not enough: to produce a satisfactory reply the respondent needs first to understand what the citizen objects to, and then to give an answer to the specific points. This may not be entirely straightforward: often the writer will be unclear or ambiguous or lack focus. In our example, the citizen might object to the closure of the library on a number of different grounds such as a lack of alternative libraries in the local area, or the council's allocation of funds across its services, which must be first disentangled and then answered separately.

For the third type of letter, even more is required. First a well formulated proposal must be stated, and then that proposal can then be critiqued from the standpoint of the government's own beliefs and values. Both of these might prove difficult. Formulating a policy is not an easy task, and so some considerable effort might be needed to get the proposal into a coherent form. Also the critique might require a variety of different kinds of knowledge, ranging from facts, through economic models and budgetary constraints, to value choices. In our example scenario, an alternative action that might be proposed is the creation of a mobile library to serve a number of different communities and save costs.

A valuable by-product of this correspondence was that it enabled the mood of the public to be gauged: those receiving and replying to this correspondence could get a feel for which aspects of policy were popular and which were unpopular, and which alternatives were well supported. But such knowledge tended to be anecdotal and impressionistic: the paper process did not lend itself to systematic quantification.

Nowadays e-mail and the internet offer a better way of conducting this kind of dialogue. But while communication is quicker and more convenient, the task remains difficult. It is still hard to formulate policy proposals, justifications and critiques cogently. Nor does standard e-mail correspondence lend itself to statistical aggregation. But there is no obligation simply to replicate the existing process. E-participation does offer opportunities to provide support for understanding inquiries, formulating replies and the aggregation task required to make sense of the feedback. Unfortunately these opportunities have rarely been taken.

Current e-participation systems too often lack structure. Most commonly they take the form of petitions or threaded discussions. Petitions allow the

expression of general feelings, but they are unable to express objections with precision. Too often they are ill expressed and conflate a variety of different arguments, so that it is not clear what people are subscribing too. Threaded discussions allow people to feel that they have expressed their views, but they too lack structure. Thus arguments are typically ill-formed, and the lack of structure also makes comparison, aggregation and assimilation difficult. In consequence, government replies are often general, bland and superficial; they fail to address the particular objections of the citizens; and the views expressed by the citizens remain hard to quantify. To address these issues, we believe that tools that are firmly grounded on a well defined model of argument are needed.

Following a discussion of some existing tools, and their limitations, we introduce our model of argument. We present an underlying semantic structure and argument scheme for the justification of policy proposals, along with ways of critiquing such justifications in terms of its structure. We also offer a detailed example, instantiating the formal structure with a representation of a real policy debate: whether speed cameras should be introduced on major roads. This will form a running example for use in the following sections where we introduce our two tools, directed in turn at each of the second and third tasks described above, and at the collection and aggregation of information from the dialogues. Finally we offer some concluding remarks.

2 Existing Tools

From a developer's point of view, a key consideration in designing and building on-line tools for e-participation is the trade-off between the amount of structure provided by the tool and its ease of learning and use. Since the target audience is the general public, participation must be fostered by making the interactive system as straightforward to use as possible. If, however, the responses are to be meaningfully analysed in terms of their content, then considerable structure needs to be imposed on the data. In this section we will discuss some existing tools[2] and then summarise what we see as their limitations.

2.1 E-Petitions

The simplest e-participation tool is the e-petition. This allows people to register a petition, criticising a policy or advocating a change of policy, and provides the means for other people to endorse it. This is the modern version of a very traditional method of expressing grievances: since at least the eighteenth century

[2] The IMPACT project ran from January 2010 until December 2012. The tools described here are predominately those that provided the context for the developments of that project, which are the main topic of this paper. Since then, social media, especially Twitter, has become widely used, and several e-participation developments have attempted to reflect this. Thus the focus remains very much on the communications channel, and it remains true that there has been little attention paid to providing more structure and coherence to the utterances.

people went round with paper petitions gathering signatures and presenting them to their rulers. Given enough signatures, the government may issue a reply, or the issue might even be debated in Parliament. But really, apart from convenience, the e-petition represents little by way of progress from the paper version.

Under the previous Labour administration (1997–2010), the UK government introduced a much used e-petition site[3]. The motivation was stated on the site as *e-petitions is an easy way for you to influence government policy in the UK*. These e-petitions could address anything for which the government is responsible. Once a petition got at least 100,000 signatures, it was eligible for debate in the UK parliament. A similar site was also used by the US government where an official response was issued once the petition reached a threshold number of signatures.

Whilst these e-petitions indeed proved easy to use, easy to respond to and facilitated signature collection (one particular petition in the UK gained over 1.81 million electronic signatures), the *quality* of engagement they offered is questionable. Such e-petitions are simply electronic versions of paper petitions, and they suffer from the same shortcomings as paper versions, the most significant being the conflation of a number of issues into one catch-all statement. As Dr. Samuel Johnson wrote back in the eighteenth century:

> The petition is then handed from town to town, and from house to house; and, wherever it comes, the inhabitants flock together, that they may see that which must be sent to the king. Names are easily collected. One man signs, because he hates the papists; another, because he has vowed destruction to the turnpikes; one, because it will vex the parson; another, because he owes his landlord nothing; one, because he is rich; another, because he is poor; one, to show that he is not afraid; and another, to show that he can write.

The recipient of the petition can only assume that by signing, the signatory agrees wholeheartedly with all of the (potentially) multiple points raised in the statement. This makes it easy to over simplify and to blur the issues since it is likely that individuals object for different reasons. Consider, for example, one of the most popular petitions on the UK site which criticised a proposed reduction in the UK national speed limit on roads. The petition objected that the reduction would not make a difference to road deaths and that the subsequent cut in carbon emissions would be too insignificant to justify the speed limit reduction. Signing such a petition is an 'all-or-nothing' statement with no room to discriminate between (or even acknowledge) the two very different objections raised. In a word, the petitions lack structure. The responses provided by the government were also at a general level and not able to recognise or address particular concerns, and so typically failed to satisfy anyone fully. We need the opinions to be presented in a coherent, well reasoned, structure: *arguments* rather than mere *assertions*.

[3] A very similar site, launched by the current Conservative administration, is currently (2014) available at http://epetitions.direct.gov.uk.

2.2 Free Text Based Tools

There have been several proposals for policy-making support tools in the European Union and the United States which use currently available wiki, comment, email, or social networking technologies (see [9,16] for discussion of other tools such as IBIS+, Compendium, DebateGraph). We discuss several of these briefly in order to set the context for the contribution of our Structured Consultation Tool (which we refer to herein as the SCT).[4]

The United Kingdom's Cabinet Office *Public Reading* website[5], presented the Protection of Freedoms Bill, using a website that unfolds the proposed bill, allowing on-line readers to look at specific sections. At the bottom level, the user can use a threaded comment facility to respond to a particular portion or responses made by other users. With the Public Reading tool, it is difficult to get an overview understanding of the whole policy and the relation of responses to it. Thus, the role and impact of responses is not highlighted. There is no support for analysing the responses, which is then done "manually" by analysts of the consultation, making the contribution of the responses to any subsequent development of the policy draft obscure. Moreover, while the responses are specifically linked to parts of the legislation, the unconstrained nature of the responses means the consultation is unstructured and unsystematic. Not only does this allow inappropriate or irrelevant responses, but it may not elicit the kind of important or useful information that is the primary motivation for the consultation in the first place. The Bill itself proposes a solution to some legislative problem; comments on the Bill may discuss alternative solutions. Yet understanding the Bill or alternative solutions may rest on the motivations and justifications underlying the solutions, for example, in terms of social values that the solution promotes. Making these motivations and justifications overt would further support rational analysis and understanding of the Bill, which in turn would better represent the stakeholders' interests and objectives.

Like the UK Prime Minister's Office *e-petition* site discussed above, the European Commission's *The European Citizens' Initiative* facilities allow citizens to electronically create, sign, and submit petitions.[6] By the same token, these tools can be used to "vote" on a policy proposal. The tools, which enable respondents to submit petitions, are web-based versions of what is has been traditionally accomplished manually. Both of these tools contribute to the policy formulation stage of the policy-making cycle, but not to the comment stage. There is no analytic framework. A particular problem is that it is unclear exactly *what* respondents are signatory to; that is, it provides an unrefined *all or nothing* representation of a point of view, whereas there may well be respondents who agree with some parts of the proposal, but not other parts, yet nonetheless sign on to the whole. What is needed is support to *differentiate* and *draw out* such subtle alternative viewpoints.

[4] All websites accessed April 24, 2014.
[5] http://publicreadingstage.cabinetoffice.gov.uk/ (archive only).
[6] http://epetitions.direct.gov.uk/.
http://ec.europa.eu/citizens-initiative/public/welcome.

Other initiatives aim to improve the quality of comments on proposed legislation. The US General Services Administration used a tool to support consultation, *ExpertNet*, which drew upon "crowdsourced" expertise and attempted to structure responses with social networking facilities such as ranking responses, providing specific questions for community voting and annotating responses, among others. While this does give indicative information on respondents' reactions, the legislation is not represented in an analytic form, let alone a form able to support machine analysis. Rather, although the content of the legislation and the reactions to it must be further analysed, there is no analytic framework to support this. There are additional issues raised about how to identify, certify, and monitor the community of experts. The *RegulationRoom* is an academically hosted facility for commenting on proposed legislation, providing guidelines on effective comments. This is more substantive than ExpertNet, but it requires highly skilled individuals to follow the guidelines; it may best suit respondents who already participate in policy consultations rather than untrained members of the public.[7]

Finally, in the US state of Massachusetts, legislators provide a wiki tool, *LexPop*, to "crowdsource" the incremental development of legislation.[8] The question here concerns who is in a position to use such a tool, not just in terms of representing the interests of others and reasoning about legislation, which often requires a deep understanding of law and how to author legislation, but also reasoning about legal values and consequences. The success of current wikis (e.g. Wikipedia) rests on an often small coterie of self-selected, self-regulating authors who write about specialist topics, where questions and controversies can be left unresolved and where there are no legislated consequences.

Despite these drawbacks, these past and current tools and initiatives are clearly potentially important and useful in leveraging current technologies to draw in greater citizen participation to policy-making by making participation easier and improving the informativeness of feedback. However, providing the means to address or avoid these limitations would positively impact on policy making. In particular, the tools discussed above do not further the substantive semantic analysis of the comments in a form that supports machine-processing of rich, complex information, particularly where the comments introduce conflicts and inconsistencies that must be reasoned with. That is, they do not make use of current thinking or techniques found in Artificial Intelligence on argumentation.

2.3 Structured Tools

A key issue we have raised here with respect to tools that solicit user input in free text is how and where to impose structure to identify the arguments proposed so that the analysis of the opinions can be made meaningful, and even supported through computational analysis. An alternative, relatively untried in

[7] http://expertnet.wikispaces.com/.
http://regulationroom.org/.
[8] http://lexpop.org/.

practice, where success seems to be judged by the quantity rather than the quality of responses received, is to oblige users to conform to a restrictive structure. This may, however, inhibit their interaction or require them to understand the underlying theory. Users may then make mistakes, and their responses be precise but wrong, which is even worse than being vague. Despite the difficulties, a number of research systems have been developed with the intention of providing a better level of support. We briefly discuss some of the better known and the issues they raise.

One category of tool is argument mapping tools. Araucaria [19] is one example which enables users to mark up the premises and conclusions of arguments, and indicate particular argumentation schemes identifying patterns of reasoning. Whilst the mark-up requires users to think more deeply about the structure of their arguments, there still remains no guarantee that the semantics of the marked up text is coherent and consistent since users simply decide what text to label as premises and conclusions and what the inferences are. In consequence the tool can accept invalid mark-ups and typically there are several different, equally valid, mark-ups.

Other on-line argument mapping tools include *Debatepedia* and its replacement, *Debatabase*[9]. These are on-line 'wikis' containing an ever growing collection of arguments and debates within which users can express pros and cons of a range of issues. Although democratic in that users can freely modify others' contributions, the arguments entered are not required to conform to any particular semantics that would support coherence and argument evaluation, and so it is often difficult to relate the various points made, and to evaluate the status of the debate.

Still more structure is imposed by systems that have been built using the IBIS (Issue Based Information Systems) model of argument [15]. IBIS enables a particular problem or issue to be decomposed into a number of different positions. Arguments can then be created to attack or defend the positions until the issue is settled (possibly by a vote). A collaborative decision support system that uses this model is HERMES [14] (as does its predecessor Zeno [12]). Evaluation showed that although users enjoyed using the system it was not easy to learn and difficulties were experienced understanding the argumentation content of the system, casting doubt on the usefulness of its output.

More recently there has been a shift towards the development of tools that make use of ideas and trends from social media. A comprehensive survey of the state-of-the-art in web-based argumentation tools, which also covers a number of the tools we have mentioned above, can be found in [20].

2.4 Limitations of Existing Tools

In this section we will summarise the limitations of existing tools, which we hope to address using the model-based tools we will describe in later sections. The first problem relates to the analysis of the responses. The current tools have a

[9] http://idebate.org/debatabase.

focus on usability and accessibility, and are indeed easy and convenient to use. In consequence they have proved highly popular and successful in attracting participants. The downside, however, is that there is a lot of unstructured data collected: too much data to be able to use these responses to inform policy making. The current tools allow people to express their opinions, but do not enable these opinions to feed easily into policy making. This raises the following questions:

- How can we systematically organise the analysis of comments?
- How can we organise the information to accurately identify issues and consult participants in further depth?
- The abundance of claims, counter-claims, evidence, points of view, etc. results in a rich 'web' of information. How can we manage so large a quantity of heterogeneous data, and reason effectively with it?

As well as the quantity of data, the fact that it is unstructured - typically simply free text authored by non specialists - presents problems:

- Comments are in an unstructured and unsystematic format. While threaded lists are often used, enabling people to follow and continue a discussion to some extent, it remains difficult even for a skilled human, let alone a machine, to extract meaningful information in any systematic way.
- Threaded lists can often wander away from their original topic, so that they may become irrelevant, or relevant information may appear under unrelated headings.
- Comments are not sufficiently fine-grained to be as informative as may be needed if they are to impact on policy making. Underlying motivations and justifications are often insufficiently specific and are also often left implicit or taken for granted by users unused to framing their opinions for a general audience.

Third, since the focus is on allowing people to "have their say", many of the contributions are ill informed, biased and unbalanced. But the bias may also come from the analyst: since there is simply a mass of unstructured information, it is possible to cherry-pick the comments that one will make use of. Experts who mediate, analyse, and summarise the comments can bias information or obscure the relation between comments and policy outcomes. Outlier, hybrid, challenging, and novel positions on issues may get 'lost'. Thus the process does not produce objective, transparent results.

Finally we can see problems with the model of interaction itself. The task that the participants are asked to perform is really rather difficult, both for the citizens and the officials. They are being asked to:

- construct a coherent argument
- maintain relevance and focus
- get the facts right
- understand an argument

– identify and answer specific objections
– answer at the correct level of detail
– relate, combine and aggregate arguments.

This adds up to a rather demanding skill set which we would not expect everyone to possess. But current tools exhibit:

– Lack of support for reasoning processes (inference, modelling, consistency, alternative policy positions).
– Little interaction and feedback among stakeholders and between stakeholders and the consultative body. There is no deliberation.

Given all the issues we have raised, we see a clear need for on-line opinion gathering tools to be grounded on some solid semantic foundation whilst retaining their usability. To achieve this, we look to multi-agent systems, and in particular how the reasoning of the agents in a system can be supported by a computational model of argument. In the next section we describe an approach from this field that can provide the backbone of support for tools that can be used to improve on-line opinion gathering.

3 Policy as Practical Reasoning

While current systems make excellent use of the available technology, they serve mainly as a communications channel and lack the domain expertise and knowledge, which would be required to provide the users with support in formulating and structuring their contributions and to facilitate understanding and analysis. We therefore look to computational argumentation to overcome these deficiencies. Computational argumentation provides us with methods of argument representation and evaluation. This provides the expertise, although when building tools to support citizen participation, we must not neglect to strike a balance between the use of structured argument and ease of use of the tools. But computational argumentation also requires domain knowledge to instantiate the argumentation structures, and so we need an underlying model of the domain as well as a model of argumentation.

In this section we will describe how the model of argumentation based on argumentation schemes as proposed in [22], and in particular the argumentation scheme for practical reasoning proposed in [4], can supply the model of argumentation, and how Action-based Alternating Transition Systems (AATS), developed in multi-agent systems for reasoning about joint actions and coalitions [24] provide an appropriate model with which to store domain knowledge. Specifically we will base our tools on [2] which used AATSs to provide a formal basis for the practical reasoning argumentation scheme of [4].

3.1 Argumentation Scheme for Practical Reasoning

Practical reasoning is used to justify, or argue for, decisions as to what to *do* (in contrast to theoretical reasoning which concerns what is the case). As such

we need to recognise that different people may decide, justifiably, to do different things, because they have different desires, aspirations and preferences. As Searle [21] puts it, whereas in theoretical reasoning we attempt to fit our beliefs to the world, in practical reasoning we try to fit the world to our desires: and our desires differ.

Normally there will be aspects of the current state that the agent likes, and aspects that it does not like. So, with respect to change, the agent will have four possible motivations:

- To make something currently false true (*achievement goal*).
- To make something currently true false (*remedy goal*).
- To keep something true true (*maintenance goal*).
- To keep something false false (*avoidance goal*).

What an agent wants can be specified at several levels of abstraction. Suppose an agent enters a bar on a hot day and is asked what it wants. The agent may reply:

- I want to increase my happiness.
- I want to slake my thirst.
- I want a pint of lager.

The first reply relates to something which is almost always true, and for the sake of which other things are done. Normally there will be several things that promote this state. The second is a specific way of increasing happiness: it is a remedy goal. There is an element of the current situation the rectification of which would increase the happiness of the agent. Again there are several ways of bringing this about. Finally the third reply identifies a specific way of remedying the situation: the agent selected a lager in preference to water, juice, etc. It is a specific condition under which the goal will be satisfied. Previous work such as [2] has used *values*, *goals* and *circumstances* to refer to these three levels of abstraction. In [2] these levels are related to motivate or justify a choice through expression as an argument scheme. Argument schemes provide templates to capture stereotypical patterns of reasoning and they have associated with them critical questions to probe the presumptive conclusions that can be drawn by instantiating the schemes. A variety of different schemes is documented in the informal logic literature [22], and they are increasingly being used in computational argumentation. The following argument scheme for practical reasoning distinguishes the three levels of abstraction discussed above:

PRAS: In the current circumstances R, I should perform action A, to bring about new circumstances S, which will achieve goal G and promote value V.

Applied to the example above, this would give: *In the pub (current circumstances), I should order a lager (action), to have a drink (new circumstances), which will slake my thirst (goal), which will increase my happiness (value).* Policy making can be seen as conforming to this model. The policy makers will have

some values which they wish to pursue. This language of values is very common in contemporary politics, and voters often choose between parties on the basis of their perceived values rather than on the basis of specific policy proposals. Values can only be realised, however, through concrete action, and this requires a set of goals to be adopted. Finally ways of realising these goals must be identified and actions to bring the required circumstances about must be identified. Thus we can see policy making as a form of practical reasoning, and the argumentation scheme of [2] as a form of argument for policy justification.

We shall next describe the underlying semantic structure, the AATS, extended to include values, and how this structure can be used to instantiate arguments of the form of PRAS. We then consider how such arguments can be attacked and defended.

3.2 A Semantic Structure for Practical Reasoning

Action-Based Alternating Transition Systems (AATSs) were originally presented in [24] as semantical structures for modelling game-like, dynamic, multi-agent systems in which the agents can perform actions in order to modify and attempt to control the system in some way. These structures are thus well suited to serve as the basis for the representation of arguments about which action to take in situations where the outcome may be affected by the actions of other agents. First we recapitulate the definition of the components of an AATS given in [24].

Defnition 1: AATS An *Action-based Alternating Transition System* (AATS) is an $(n+7)$-tuple $S = \langle Q, q_0, Ag, Ac_1, \ldots, Ac_n, \rho, \tau, \Phi, \pi \rangle$, where:

- Q is a finite, non-empty set of *states*;
- $q_0 \in Q$ is the *initial state*;
- $Ag = \{1,...,n\}$ is a finite, non-empty set of *agents*;
- Ac_i is a finite, non-empty set of actions, for each $i \in Ag$ where $Ac_i \cap Ac_j = \emptyset$ for all $i \neq j \in Ag$;
- $\rho : Ac_{Ag} \rightarrow 2^Q$ is an *action pre-condition function*, which for each action $\alpha \in Ac_{Ag}$ defines the set of states $\rho(\alpha)$ from which α may be executed;
- $\tau : Q \times J_{Ag} \rightarrow Q$ is a partial *system transition function*, which defines the state $\tau(q, j)$ that would result by the performance of j from state q – note that, as this function is partial, not all joint actions are possible in all states (cf. the pre-condition function above);
- Φ is a finite, non-empty set of *atomic propositions*; and
- $\pi : Q \rightarrow 2^\Phi$ is an interpretation function, which gives the set of primitive propositions satisfied in each state: if $p \in \pi(q)$, then this means that the propositional variable p is satisfied (equivalently, true) in state q.

AATSs are particularly concerned with the joint actions of the set of agents Ag. j_{Ag} is the joint action of the set of n agents that make up Ag, and is a tuple $\langle \alpha_1,...,\alpha_n \rangle$, where for each α_j (where $j \leq n$) there is some $i \in Ag$ such that $\alpha_j \in Ac_i$. Moreover, there are no two different actions α_j and $\alpha_{j'}$ in j_{Ag} that belong to the same Ac_i. The set of all joint actions for the set of agents Ag is denoted

by J_{Ag}, so $J_{Ag} = \prod_{i \in Ag} Ac_i$. Given an element j of J_{Ag} and an agent $i \in Ag$, i's action in j is denoted by j^i.

To represent the values within our reasoning framework, the AATS structure must be extended to enable the representation of values, which was done in [2]. For this, a set V of values was introduced, along with a function δ to enable every transition between two states to be labelled as either promoting, demoting, or being neutral with respect to each value.

Definition 2: AATS+V

Given an AATS, an AATS+V is defined as follows:

- V is a finite, non-empty set of values.
- $\delta : Q \times Q \times V \rightarrow \{+, -, =\}$ is a *valuation function* which defines the status (promoted (+), demoted (–) or neutral (=)) of a value $v_u \in V$ ascribed to the transition between two states: $\delta(q_x, q_y, v_u)$ labels the transition between q_x and q_y with one of $\{+, -, =\}$ with respect to the value $v_u \in V$.

An *Action-based Alternating Transition System with Values* (AATS+V) is thus defined as a $(n + 9)$ tuple $S = \langle Q, q_0, Ag, Ac_1, ..., Ac_n, \rho, \tau, \Phi, \pi, V, \delta \rangle$.

This formalism was used in [2] to formalise the PRAS argumentation scheme introduced informally in the previous section.

Definition 3: PRAS

In the initial state $q_0 = q_x \in Q$,
Agent $i \in Ag$ should participate in joint action $j_n \in J_{Ag}$

where $j_n^i = \alpha_i$,

and $\tau(q_x, j_n)$ is q_y,

and $p_a \in \pi(q_y)$ and $p_a \notin \pi(q_x)$, or $p_a \notin \pi(q_y)$ and $p_a \in \pi(q_x)$,

and for some $v_u \in V$, $\delta(q_x, q_y, v_u)$ is $+$.

3.3 Attacking and Justifying Policy Arguments

An important feature of argumentation schemes as described by Walton [22] is that they only *presumptively* justify their conclusions. Moreover, each argumentation scheme has its own characteristic ways of being attacked. Walton termed these methods of attack "critical questions". In [2] seventeen ways to attack arguments based on PRAS were identified, and these were divided into three different types of critical question:

- *problem formulation*: deciding what the propositions and values relevant to the particular situation are, and constructing the AATS. There are eight such attacks. These concern the propositions used in the state descriptions, the actions available and their effects, which values exist and which transitions promote and demote them.

- *epistemic reasoning*: determining the initial state in the structure formed at the previous stage, and which joint action will be performed. There are two such attacks: one challenging the current circumstances and one questioning the anticipated behaviour of the other agents involved in joint actions.
- *choice of action*: These are the remaining seven attacks, which involve consideration of alternative ways of achieving goals and values; side effects that that will demote values, and passing up an opportunity to promote some other value. Essentially these will be resolved according to the value preferences of the individual acting as the audience for the argument.

These different categories of attack can be seen as requiring resolution at different levels. The problem formulation attacks are the most fundamental: they express differences about what is relevant, the results of actions, what promotes values, and the like. Differences at this level necessitate different models of the world: they require those disagreeing to have a different AATS in mind. Epistemic questions are not fundamental: they do not need a different AATS, but they do seek to establish agreement as to where we are in the structure and what paths we will follow. Either there must be a recognised way of determining the "truth of the matter", or else disputants must agree to proceed on the basis of assumptions. For choice of action, however, disagreement is to be expected, since differences turn on the different priorities given to the various social values involved. The set of arguments generated will be the same, but they will be evaluated differently by different audiences.

With regard to answering such attacks, analysis in [9] suggested that the underlying claims were typically justified by citing some credible source. This might be expert opinion, the conclusion of some scientific survey, a public opinion poll, witness testimony, or - in the case of value statements - party manifestos. Rarely were arguments from first principles used. Credible source arguments cover a number of the argument schemes given in [22]. The work of [9] suggests a three ply model: a policy justification using PRAS; a challenge based on one of the characteristic ways of attacking PRAS; and a rebuttal of the attack using a credible source argument appropriate to the topic concerned. Further discussion of credible source as an argument scheme can be found in [28].

4 Case Study: Speed Cameras

The formal machinery using the AATS+V is intended to provide the basis for the specification of semantic models which enable arguments about policy proposals to take place. We now consider the general process of policy making, and show how policies can be modelled and argued about, using a running example. The example is an issue in UK Road Traffic policy, previously used as an e-participation example in [3,5,10]. The number of fatal road accidents is an obvious cause for concern, and in the UK there are speed restrictions on various types of road, in the belief that excessive speed causes accidents. The policy issue which we will consider is how to reduce road deaths.

The starting point of policy making is when a policy issue on a particular topic is identified and the relevant governing body wishes to launch a consultation to solicit views on the issue. Since there is no specific commitment to a particular action at this stage, a *Green Paper* on the issue will be released publicly. The Green Paper is intended to encourage debate, with a view to interested parties, such as unions, pressure groups, think tanks, companies, universities etc., putting forth their views and comments on the issue, which they submit as formal responses. Considering our running example, the Green Paper would solicit opinions on the issue of what to do to reduce road deaths.

At this deliberative stage of the process, typically a wide range of proposals is put forward representing the different perspectives of different parties with different expertise, interests and values on the issue. For these to inform policy making, the relevant government department must analyse them to identify relevant facts, theories, interests and values, trying to synthesise them into some coherent form which can provide the basis of deliberation as to the policy to recommend in the subsequent *White Paper*. A White Paper sets out a concrete policy intended to form the basis of legislation and its justification. Again comments are sought from interested parties on the White Paper, but now with this rather specific focus. In short, when moving from the Green Paper to the White Paper, the government department tries to make sense of the alternative views submitted to try to produce a coherent picture of the domain of interest. Of course, this sense-making is not at present done using any formal apparatus. We argue, however, that such sense-making could be facilitated by formally representing the alternative views as AATS+V models, then reasoning with these models using argumentation schemes. This would clarify the alternative positions on the policy, force reconciliation of any incompatible views, and provide an integrated summary of the consultation. This aspect is discussed in more detail in [3].

4.1 Constructing Semantic Models of Policies

To fully describe a model using the AATS+V we need to specify the various components of the structure. We need the set of propositions Φ with which we can identify the possible member states of Q. Since if there are n elements in Φ there may be 2^n elements in Q, it is desirable to keep Φ as small as possible and only include propositions if they are definitely relevant to the problem. Given Φ, we can constrain the size of Q by identifying logical relationships between members of Φ, such that for $p_1, p_2 \in \Phi$, $\neg(p_1 \wedge p_2)$, which will allow the elimination of certain states. We need to give the set of agents, Ag, the actions they can perform, and any values inherently promoted or demoted by the performance of the action. Again, in order to keep the number of joint actions within reasonable bounds, we will need to be as frugal as possible in including agents and actions: n agents, each with m actions, give rise to n^m potential joint actions. Again this is an upper bound: some pairs of actions may be incompatible and so give rise to no joint action. Finally, we need a transition matrix expressing ρ, τ and δ. This matrix comprises a row for each state in Q and a column for

each joint action in J. An entry in a cell indicates that the preconditions for the joint action are satisfied, and comprises a triple consisting of the state reached if that joint action is executed, the set of values promoted, and the set of values demoted. These transitions are a representation of a causal theory which explains the effects of various actions, and an evaluative theory which tells us when values are promoted and demoted.[10]

Returning to our running example, we suppose that we are trying to develop a policy to reduce road traffic deaths and have received responses to a Green Paper from which we will extract the various components of the AATS+V. As there may be alternative responses, we may need to create alternative models, or use the responses to build incrementally a complex model which represents the sum of the policy deliberations. The representation process is described in detail in [3], and also discussed with reference to a different domain in [18].

For example, one response to the Green Paper issue put forward by those concerned about road safety might be that we install and operate speed cameras at strategic points. The speed cameras automatically photograph speeding cars, and the photographs are subsequently used to identify the car and issue speeding tickets to the drivers; we will use the installation of the cameras to refer to this overall process. There is evidence from other countries and pilot studies that this measure can be effective. So we might propose the following as the intended meaning of the response: *The government should install speed cameras to reduce road deaths, which will promote the value of Life.* However, we want to argue about policy using our practical reasoning argumentation scheme, which explicitly references circumstances and consequences. The response just given is elliptical, having only the action and the value. So to be compatible with PRAS, we need to add the current circumstances (that road deaths are too high, and that speeding is rife), and a consequence (that there will be fewer accidents and so fewer deaths). There is still some magic here, however: it is not the speed cameras themselves that reduce the accidents: the belief is that speed cameras will cause motorists to observe the speed limits, that observing speed limits will reduce accidents, and this will lead to fewer deaths, and so we need to include motorists and how they change their behaviour in response to the policy in our model.

From this initial conceptualisation of the problem, we present an initial model in the form of the following AATS:

- $Q = \{q_0, q_1, q_2\}$. Although we have two propositions (and so four potential states) we model the assumption that a reduction of speeding will reduce road deaths and so ignore the state $r, \neg s$.
- $Ag = \{G, M\}$, where G is the government and M is motorist[11];
- $Ac_G = \{G_1, G_0\}$, which are the actions the government does or does not perform, respectively. $Ac_M = \{M_1, M_0\}$, which are the actions the motorist

[10] In order to keep matters simple we chose to restrict goals to elements of Φ and conjunctions thereof for both our tools. The machinery to handle more complex goals is fully described in [1].

[11] Where *motorist* is an abstraction to use the 'collective' interpretation of 'motorist'.

does or does not perform. Here G_1 is *operate speed cameras*, and M_1 is *cut speed*. G_0 and M_0 are, respectively, that the government and the motorist do nothing.
- $\Phi = \{r, s, \neg r, \neg s\}$. where r represents road deaths being high and s represents there being excessive speeding. While we informally also have have a proposition a representing a high accident rate, we assume, to keep the number of states down, that a and r can be taken as equivalent, since accidents and deaths are correlated;
- $V = \{\text{L}\}$. Our one value is saving lives.
- δ is such that $\delta(q_x, q_y, \text{L}) = +$, if r holds in q_x and $\neg r$ holds in q_y; $-$ if $\neg r$ holds in q_x and r holds in q_y; and $=$ otherwise.
- π is a function such that $\pi(q_0) = \{\text{r, s}\}$, $\pi(q_1) = \{\neg\text{r, s}\}$, and $\pi(q_2) = \{\neg\text{r, }\neg\text{s}\}$;
- J_{Ag}, the set of all joint actions, is $\{j_0, j_1, j_2\}$, where j_0 is $< G_0, M_0 >$, j_1 is $< G_1, M_0 >$, j_2 is $< G_1, M_1 >$. We have eliminated one logically possible joint action by assuming that Motorists do not cut their speed if the government does nothing.

The model also requires the functions ρ (for action pre-conditions) and τ (for system transitions). We can express these as in a transition matrix shown in Table 1: an entry in a cell indicates the pre-conditions for the joint action are satisfied; the first argument is the state reached if that joint action is executed, the second is the set of values promoted, and the third is the set of values demoted; where no value is promoted or demoted, we have "_"; *null* means the pre-conditions of one or more of the component actions cannot be satisfied, so that joint action is not possible in that state. This is true of j_0 in q_2 in our example: in the case where the speed cameras have succeeded in reducing speeds, it is assumed that the government will continue to operate them, so that only the joint actions containing G_1 are possible in q_2.

Table 1. Initial Transition Matrix

	j0	**j1**	**j2**
q0	⟨q0,_,_⟩	⟨q0,_,_⟩	⟨q2,+L,_⟩
q1	⟨q1,_,_⟩	⟨q1,_,_⟩	⟨q2,_,_⟩
q2	null	⟨q0,_,$-L$⟩	⟨q2,_,_⟩

A second response might be from a group of people who dispute that excessive speeding is a factor in deaths. In order to represent that the effect of actions can be indeterminate, we introduce a third agent N, which is usually termed *nature*, and distinguish two joint actions containing the indeterminate action, depending on whether nature cooperates, (here, meaning that a reduction in speed has the desired effect on deaths), or nature does nothing, (which here means that a reduction in speed does not have the desired effect).

The second response was intended as an objection to speed cameras. A third response might, however, provide a rebuttal to this objection by saying that even if compliance with speed limits did not have a significant effect on accidents, it would still be worthwhile, since it would mean that there was increased compliance with the law, and that this is a value in itself (C).

Next we may need to add some additional aspects, considering the cost of the proposal and an alternative proposal involving education. Speed cameras cost money, and there is only a limited budget available for improving road safety. We therefore need to consider monetary matters. This will relate to a value B, which is demoted if the budget is exceeded and promoted if there is a surplus. Assuming we do have money to spend, we can cost our plan and interpret the action of introducing cameras as being the introduction of such speed cameras as the budget will allow. Where cameras are installed according to budget the action is neutral with respect to B and so the transition will be neutral with respect to B. If, however, motorists fail to respond to the deterrent effect of the cameras, continue to speed, and pay the fines, then, because we can easily identify and prosecute the speeders, income from fines will be greater than expected and the expenditure will be recouped.

For an alternative action, suppose there is a submission by a group who believes that introducing speed cameras will not reduce road deaths, but is very much in favour of reducing these deaths. They may argue that some other action (G_2) is required to be effective. For example, if we were to educate drivers, so that they were better aware of the effects of speed, and better able to handle their vehicles at speed, then we would expect to reduce accidents, and hence deaths. Thus the government's education of drivers would, it is argued, lead to a reduction in deaths whether or not speeding decreased, since motorists who continue to speed are better able to control their cars. The only problem is that education is more expensive than cameras and does not give rise to any revenue stream, and so this proposal would be over budget, demoting B.

All this gives the final AATS+V shown diagrammatically in Fig. 1.

To keep the set of actions small, the action used to represent education can also be used to represent any other government actions which it is claimed will lead to a reduction in accidents but which will exceed the budget, such as deploying increased numbers of traffic police to catch speeders. Note, however, that we now need to distinguish between speeding and accidents, and so require the fourth state where speeding continues, but deaths decrease, reachable by the joint action educating motorists who continue to speed.

Finally, we will consider responses to the Green Paper that are representative of arguments from Civil Liberties pressure groups. They argue that speed cameras, by revealing the location and movements of citizens, represent an unacceptable intrusion of privacy. This requires a new proposition (p) to represent the existence of the speed cameras making an excessive intrusion on privacy. This will be accompanied by an additional value, F representing civil liberties. This requires an extension to the model: adding p splits every state reachable by introducing cameras into two to distinguish states where privacy is respected from those where it is not.

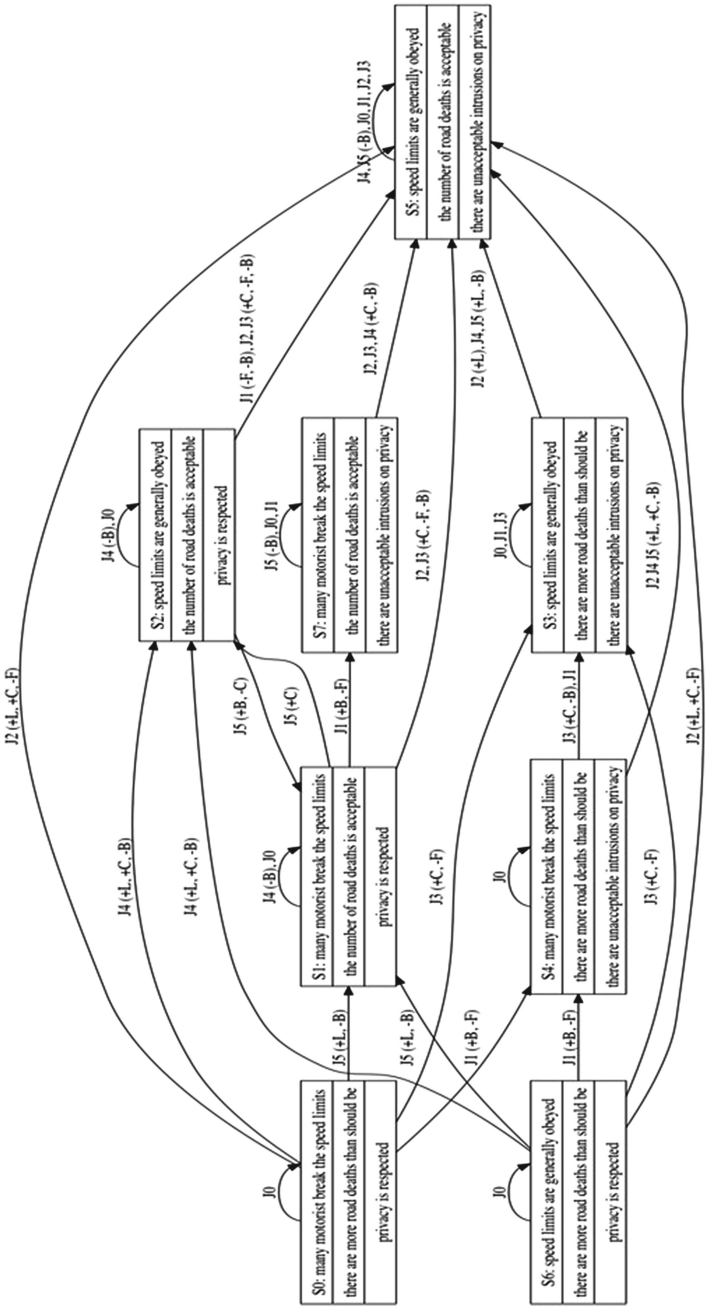

Fig. 1. AATS+V for Speed Camera Domain

Formally the components of this AATS+V are:

- $Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6\}$.
- $Ag = \{G, M, N\}$, where G is the government, M is motorist and N is Nature.
- $Ac_G = \{G_2, G_1, G_0\}$, which are the actions of the government, respectively educate motorist, introduce cameras, and take no action. As before, $Ac_M = \{M_1, M_0\}$, and AC_N is $\{N_1, N_0\}$, depending on whether or not reducing speed also reduces deaths.
- $\Phi = \{r, s, p, \neg r, \neg s, \neg p\}$, where r represents road deaths being high, s represents there being excessive speeding and p represent unacceptable intrusions on privacy.
- $V = \{\text{L, C, B, F}\}$, as explained above.
- δ is such that $\delta(q_x, q_y, \text{L}) = +$, if r holds in q_x and $\neg r$ holds in q_y; $-$ if $\neg r$ holds in q_x and r holds in q_y; and $=$ otherwise. $\delta(q_x, q_y, \text{C}) = +$, if s holds in q_x and $\neg s$ holds in q_y; $-$ if $negs$ holds in q_x and s holds in q_y; and $=$ otherwise. $\delta(q_x, q_y, \text{B}) = +$, if the transition between q_x and q_y contains both G_1 and M_0; $-$ if the transition between q_x and q_y contains G_2 and $=$ otherwise. $\delta(q_x, q_y, \text{P}) = +$, if $\neg p$ holds in q_x and p holds in q_y; $-$ if p holds in q_x and $\neg p$ holds in q_y; and $=$ otherwise.
- π is a function such that states are interpreted as shown in Fig. 1.
- J_{Ag}, the set of all joint actions, is $\{j_0, j_1, j_2, j_3, j_4, j_5\}$, where j_0 is $< G_0, M_0, N_0 >$; j_1 is $< G_1, M_0, N_0 >$; j_2 is $< G_1, M_1, N_0 >$, j_3 is $< G_1, M_1, N_1 >$, j_4 is $< G_2, M_1, N_1 >$ and j_5 is $< G_2, M_0, N_1 >$.

The functions τ and ρ are shown in the transition matrix in Table 2.

Table 2. Final Transition matrix.

	j0	**j1**	**j2**
q0	⟨q0,-,-⟩	⟨q0,+B,-F⟩	⟨q5,+L+C,-F⟩
	j3	**j4**	**j5**
q0	⟨q6,+C,-F⟩	⟨q2,+L+C,-B⟩	⟨q3,+L,-B⟩

When the response period for the Green Paper closes, the opinion gathering ends and the policy analyst can then focus on the proposal to be chosen as the preferred option to be set out in the White Paper, forming the next part of the process. It is at this point that we envisage the Structured Consultation Tool described below being deployed.

4.2 Implementation

Once we have identified the elements of an AATS+V, implementation is straightforward. The AATS+V is described by representing three relations: states, joint

actions, and transitions. These relations are represented in data structures appropriate to the language of choice. In Prolog they would be clauses: if using a database they would be tables. The Prolog prototype was described in [25] and the database version is described in [23] and, more fully, in [27]. Sample Prolog clauses for the above AATS+V would be:

```
state(0,1,3,6).
jointAction(j0,[do,nothing],[do,nothing],[have,no,effect]).
transition(1,0,5,j2,[l,c],[f]).
```

where state has an id, and a literal for each of r, s, and p; joint action has an id, and action for each of the three agents; and transition has an id, a source state, a target state, a set of values promoted and a set of values demoted. Additional relations can be used to provide additional information such as textual descriptions:

```
value(4,b,budget).
action(government,3,[educate,motorists]).
literal(1,1,[there,is,excessive,speeding],[]).
```

Now we can run appropriate queries to instantiate PRAS and attacks upon its instantiations. For example we can instantiate PRAS using the Prolog query:

```
argumentPro(A,S,R,V):-transition(ID,S,R,J,X,_),
                      member(V,X),
                      jointAction(J,A,_,_)
                      ([government,should,A,in,S,to,reach,R,
                      and,promote,V]).
```

and identify an attack based on the demotion of a value with:

```
argumentCon(A,S,R,V):-transition(ID,S,R,J,_,X),
                      member(V,X),
                      jointAction(J,A,_,_),
              write([government,should,not,A,in,S,to,avoid,R,
                                        which,would,demote,V]).
```

It is a simple matter to write equivalent queries in SQL if using a database (see [27]).

5 Justifying and Critiquing Policies

In this section we will describe our applications built using the apparatus described above. We have two tools: one, the SCT, presents a justification of a policy and receives feedback on which points the citizens agree with and which points they disagree with. The second tool, the Critique Tool (CT), reverses the

roles; this tool solicits a proposal from the citizen and then provides a critique from the government perspective.

The idea is that internally the system will operate by instantiating PRAS and attacks upon these instantiations based on the AATS+V, which represents the domain model. All of this will, however, be hidden from the users who will be presented with a series of screens presenting these justifications and attacks, and users will be asked to answer "yes" or "no" to indicate their agreement or disagreement. Once given, these answers can be interpreted in terms of the model, so that the statements agreed with become justifications and attacks on justifications. This further allows the responses to be aggregated so that it becomes clear what the specific strengths and weaknesses (as perceived by the citizens) of a policy justification are.

Both tools are implemented in MySQL and then embedded in PHP to provide access over the internet. The tools are (May 2014) available at

- http://impact.uid.com:8080/impact/ and
- http://cgi.csc.liv.ac.uk/~maya/ACT/

5.1 Structured Consultation Tool (SCT)

The role of the SCT is:

- to present the justification of a policy to members of the public;
- to allow members of the public to disagree with certain specific points of that justification;
- to present Credible Source arguments to justify the points disagreed with.

In this way the popularity of the policy can be gauged, and, if it is not supported, the reasons why it is not popular identified. The AATS+V can be used to instantiate a justification for the policy for presentation to the public using the SCT. Feedback on the argument and the model used is then sought, concerning disagreements and omissions, the assumptions made, and the ordering of values chosen.

After an initial statement of the justification, participants who disagree are led through a series of screens to identify the particular points at which they disagree, or want further justification. Further justification of specific points is given by a "digression" which presents (and receives feedback on) an appropriate credible source argument.

- *Screen 1* asks about the current state. For each proposition in the current state, the participant is invited to agree or disagree that it is the case. This corresponds to an epistemic challenge on the beliefs as to what is current the case. If there is disagreement, evidence is presented (e.g. accident statistics). If the participant remains unconvinced, the argument supporting the premise can be critiqued. The first screen also asks the participant to list any other

relevant facts that need to be considered. To give an example of the look and feel of the system, a screen shot is shown in Fig. 2[12].

- *Screen 2* asks questions such as "Do you agree that reducing road deaths promotes life?", so that each of the labellings of the relevant transitions can be questioned. This effectively challenges the way the δ function has been defined in the AATS+V.
- *Screen 3* relates to the states reached by a transition. Participants are asked if the propositions claimed to be true in the next state will indeed result from the action. This challenges the underlying causal model relating actions and outcomes in the AATS+V. Disagreement will result in an argument justifying that transition being shown, and either participants will accept this and return, or be led through a critique of this further argument justifying the causal relationship. This screen also offers the opportunity to identify unstated consequences of the action thought relevant and undesirable.
- *Screen 4* offers a range of other actions (such as G_2 in the speed camera example) which participants may think achieve the aims of the policy. Selecting one of these leads to the reason for rejecting it (in the example, that this action would be beyond the available budget). Any other alternative actions not included in the AATS+V supported by participants may be entered as free text.
- *Screen 5* asks about values: whether participants endorse the values used, or want other values considered, and gives the opportunity to express their ordering of values. This is to explore whether it is the desirability of the policy rather than its effectiveness and feasibility that is being challenged. Such challenges are intrinsically subjective, whereas the earlier challenges can be seen as objective.

When participants have submitted their opinions, we can see whether our proposed policy commands popular support and, if not, exactly why not. Screen 1 should confirm that the number of deaths and accidents are seen as a problem, and asks for any factors other than speeding which may be seen as a cause of the problem. A substantial write-in for poor lighting, coupled with later comments, would indicate that a different approach has popular support. Screen 2 is about the link between goals and values. It may be that people disagree that cameras represent an unacceptable intrusion on privacy, which would be good news for advocates of the policy of introducing cameras. Screen 3 allows the underlying causal model to be questioned. This is the opportunity to deny that speeding causes accidents, and, for example, to offer poor lighting as an alternative cause. Screen 4 gauges support for G_2, and is where people may suggest other alternatives, such as improved lighting. The acceptability of the budgetary argument against G_2 is also indicated by the reception of the argument against G_2 in the digression. Finally Screen 5 tests our assessment of value priorities. We ranked life above privacy; this may be endorsed or disputed. The advantages of the SCT over current tools are:

[12] The application shown in the screenshot is that addressed by the IMPACT project, concerning a copyright topic. See [18].

- Justification is structured;
- Both citizens and officials are helped to make good arguments;
- Interaction has a natural flow;
- Replies are cogent and to the point;
- Specific points of disagreement are identified;
- No training or theory is required;
- Users only have to answer yes or no;
- The structure allows for replies to be related and aggregated;
- Which aspects of the policy require change or better explanation are identified.

5.2 Critique Tool

The second tool reverses the roles of the SCT: now it is the citizen who is providing the proposal and the justification and the tool which supplies a critique by finding objections using the model.

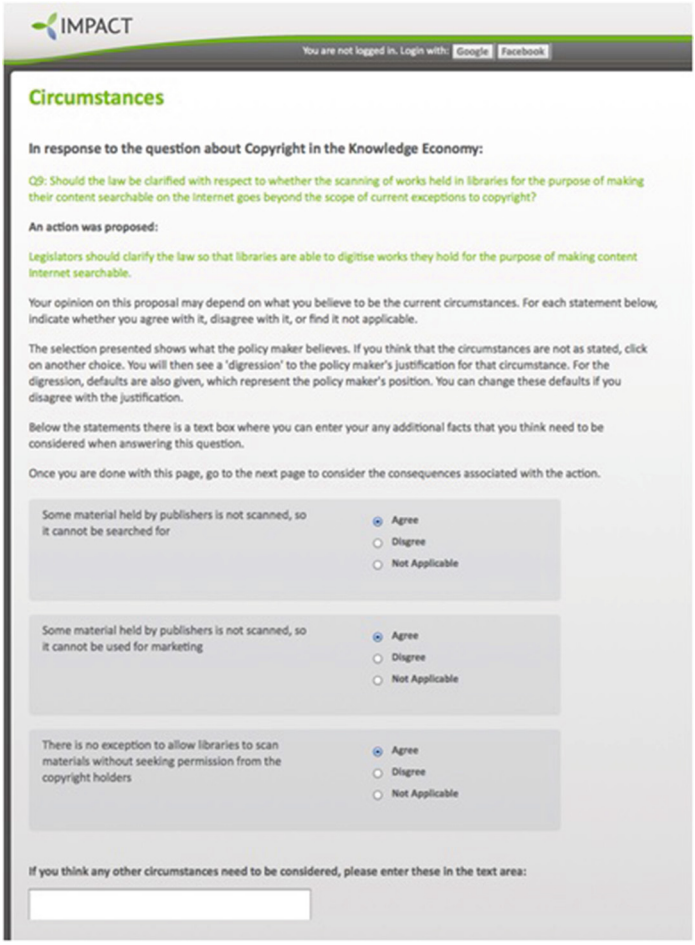

Fig. 2. Screenshot of the SCT

The first thing to do is to get the proposal. This is done by guiding users step by step through the instantiation of PRAS with respect to their conceptualisation of the domain, but requiring only "yes" or "no" responses. Thus users are presented with the screen shown as Fig. 3.

Note that the relevance of circumstances is determined by what the government considers relevant. This can, of course, be seen as a weakness, but it reflects that proposing a policy will only be persuasive if it is couched in terms acceptable to its audience [6], which, in the context of this tool, is the government rather than the citizen. The user having indicated which propositions are believed, the responses will be checked against q_0. The answers may be agreed, as in Fig. 3, or arguments justifying the different beliefs presented. This could be done using credible source arguments, as the digressions of the SCT, or simply by presenting some justifying text or web resource, as in the prototype critique tool. Users may at this point change their minds or stick with their original beliefs, in which case the consultation will proceed using their assumptions (i.e. the state believed by the user is taken as q_0.)

Next a set of alternative actions is presented, and users are invited to choose an action. The action is checked for its pre-conditions being satisfied, and if the pre-conditions are not satisfied, this will be explained. If the action is accepted as possible, the expected consequences are sought, using a screen similar to that relating to circumstances. Again any points of disagreement are identified, and supported with arguments, and the users invited to change their beliefs. Users are then invited to say which values they believe will be promoted, and again this is checked against the model.

Fig. 3. Getting the Circumstances in the Critique Tool

This completes the solicitation of an instantiation of PRAS, and so at this stage we will have an argument justifying a policy which is valid according to the model. Although this means that the argument is a valid argument, there may be a number of reasons why it might be considered unacceptable:

- It may have undesirable side effects, demoting values;
- There may be other, perhaps better, ways of promoting the values;
- It may be possible to promote different, perhaps preferable, values;
- Other agents may not respond as anticipated.

All of these objections can be identified by posing simple queries to the model, and are then presented to the user using the screen shown in Fig. 4.

The strengths of the Critique Tool are that the argumentation scheme, critical questions and the underlying model together allow a systematic and intelligent critique of a proposal to be automatically generated from the model. This:

- Challenges assumptions and factual errors;
- Provides supporting arguments if required;
- Offers alternative ways of promoting the desired values, and alternative values that can be pursued in the circumstances, and identifies flaws in the arguments, and any potentially damaging side effects and risks posed by others not behaving as anticipated.

Like the SCT, the responses made using the Critique Tool can be interpreted, stored and aggregated, in terms of the argumentation scheme and the AATS+V.

5.3 Linking to Other Sites

As well as their primary purpose of getting feedback from citizens on policy issues, the tools can also be a means for members of the public to explore and learn about the various issues. The fact that the tools are embedded in the internet means that there is ready access to a wealth of information. The two tools offer different ways of justifying claims: the SCT using digressions to present arguments based on credible sources which can be interacted with, and the Critique Tool referring on to the credible sources themselves. It would also be possible to combine these methods; first presenting the credible source as a web page and then summarising it as an argument that can be critiqued.

A further possibility is to present information resources putting the pros and cons of the various points to the user *before* they are asked to express their beliefs and opinions. This puts the user in the position of an arbiter rather than a proponent of a particular side of the debate. Such a tool might be especially useful at the Green Paper stage of a policy consultation.

5.4 Evaluating the Responses

Both tools serve to collect responses which can be organised as arguments and counter arguments. This means that as well as purely numeric processing, which

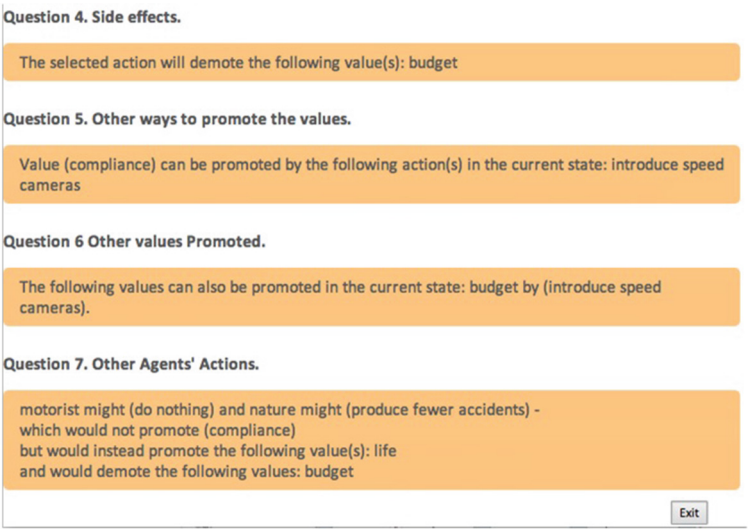

Fig. 4. Possible Objections to the User's Proposal

would enable us to say, for example, that 90 % of respondents agree that there are too many road deaths, and that 87 % agree that introducing speeds cameras would ameliorate this, we can take advantage of the argument structure. In computational argumention, since the introduction of argumentation frameworks by Dung [11], much has been done to determine the status of arguments in a framework of conflicting arguments and counter arguments. These techniques have also been applied to arguments which vary in strength according to the preferences of their audiences, in particular preferences based on value orderings (Value-based Argumentation Frameworks) [7] and preferences which can themselves be argued for (Extended Argumentation Frameworks) [17]. The idea is to find consistent sets of arguments which support one another and so form coherent positions on an issue, or identify which arguments require particular assumptions. These techniques can support both the initial policy choice, and the analysis of responses received from our tools. This argumentation oriented assessment of responses is explored in [9] and formulation and assessment of arguments about speed cameras using value-based argumentation frameworks is described and discussed in [3].

6 Concluding Remarks

A major problem with current e-participation systems is organising the replies for comparison, aggregation and assimilation. One answer to this is to make use of a well defined argumentation structure to organise policy justifications and critiques of these justifications. We have described:

– An argumentation scheme to structure justification and critiques;
– A semantical structure for models to underpin this scheme;
– A tool to facilitate a precise critique of the scheme;
– A tool to elicit a well formed justification and generate an automatic critique.

Both tools operate on the same underlying models of argumentation and of the domain. Some small scale evaluation exercises have been conducted with the SCT, and its earlier incarnation as described in [9]. Initial feedback about early versions of the SCT was positive about the aims of the system, in terms of supporting participatory democracy, and the ease with which the tool could be learned and used. However, users also expressed a desire to be able to put forward their own proposals. This identified the need for the Critique Tool that was subsequently developed.

Both tools are currently research prototypes and require evaluation in a serious situation concerning a genuine, live, policy issue. Building the model does require a considerable investment to time and expertise, but this is true of the conventional consultation process as well. We would argue that the potential gains from using such tools in terms of the quality of the feedback received, and the ease of analysing the feedback, would justify the effort required when undertaken as part of a consultation process. The purpose of the prototypes is to demonstrate the potential of using a well structured form of argumentation to present positions and receive feedback: we would anticipate that evaluation would identify opportunities for the tools to refined and extended.

Acknowledgements. This paper represents a consolidated version of work carried out at the University of Liverpool on the European project IMPACT (FP7-ICT-2009-4 Programme, Grant Number 247228). The views are those of the authors. It is a revised and much extended version of a keynote talk given by the first author at DEXA 2013 in Prague [8]. It draws on a series of earlier papers: especially [3,25,26,28]. We would particularly like to thank our colleagues Maya Wardeh, who did much of the implementation, Dan Cartwright, who explored an earlier version of the Structured Consultation Tool (Parmenides) in his PhD thesis [9], and colleagues on the IMPACT project. The work described here has its ultimate origins in [13], also presented in Prague.

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