Book Title
Book Editors
IOS Press, 2003

Value-Based Argumentation for Democratic Decision Support

Katie Atkinson [1]
Department of Computer Science, University of Liverpool.

Abstract. In this paper we discuss the integration of two systems that are based on a specific theory of argumentation: the first, an existing web-based discussion forum; the second, a method to enable autonomous software agents to perform practical reasoning based upon their subscription to social values. We show how the output from the first of these systems can be used as input to the second and how the information gathered can be reasoned about through computer support. The purpose of the approach is to demonstrate how current theories of argumentation can be used to assist with the analysis of public attitude in a particular debate, with the specific example domain used being that of eDemocracy. We also provide some discussion and comparison of these current tools with similar, earlier systems.

Keywords. eDemocracy, practical reasoning, argumentation frameworks.

1. Introduction

This paper discusses the application of theories of argumentation to the domain of eDemocracy. The emergence of web technologies has led to the computerisation of numerous 'traditional' business processes in the public, as well as the private, sector. The ability of the public to interact with their rulers through online provisions has led to the emergence of a new method of governance: eDemocracy. The transformation of democracy into an electronic medium is currently making great advances, even though the field is still relatively young. Numerous countries are engaged in the trial and development of new interactive systems for eDemocracy, such as those for e-voting [1] and proposals for new systems for eGovernment are attempting to address major issues such as trust and security e.g., [2,3]. Thus, with the introduction of safe and efficient web-based services governments have the opportunity to exploit the benefits of new computer technologies to provide accessible, efficient and useful systems through which democracy can be effectively conducted. As debate and policy justification are key elements of eDemocracy, support for systems promoting such interactions can be enlisted through the implementation of theories of argumentation to underpin these systems. The work presented in this paper aims to address some of these objectives. The paper explores how a specific computer system implemented to facilitate eDemocracy can be integrated with autonomous agent systems used to reason about the justification of arguments concerning actions. In

[1]Correspondence to: Department of Computer Science, University of Liverpool, L69 3BX, UK. Tel.: +44 (0)151 795 4243; Fax: +44 (0)151 795 4235; E-mail: katie@csc.liv.ac.uk

section 2 we give an overview of a tool, named the PARMENIDES system, developed to foster public debate on a particular political issue. In section 3 we briefly describe an approach to argument representation for dealing with reasoning about action, which can be deployed in autonomous software systems. In section 4 we describe how a link can be established between the systems described in the previous two sections. We then illustrate this approach with a short example. In section 5 we discuss how the approach presented in this paper compares and contrasts with earlier systems of similar ambition. Finally, in section 6 we offer some concluding remarks.

2. The PARMENIDES Discussion Forum

In recent years numerous computer systems have been developed which aim to facilitate the online conveyance of democracy, e.g., Zeno [4] and DEMOS [5]. This paper focuses on one particular system – the PARMENIDES system developed by Atkinson *et al.* [6] – designed to encourage public participation and debate regarding the Government's justifications for proposed actions. The PARMENIDES (Persuasive ARguMENt In DEmocracieS) system is described in [6] and the system can be used at: `http://www.csc.liv.ac.uk/~katie/Parmenides.html`.

The idea of the system is to enable members of the public to submit their opinions about the Government's justification of a particular action. In the prototypical version the subject dealt with is the 2003 war in Iraq, with the particular question under scrutiny being, "Is invasion of Iraq justified?" (as this concerns a past action, the example debate used is for illustrative purposes only). One of the key features of PARMENIDES is the underlying model upon which it is based, as the tool is intended as an implementation to exploit a specific representation of persuasive argument. The background of this model of argument is as follows.

Atkinson *et al.* have previously described an argument scheme and critical questions that provide an account of persuasive argument in practical reasoning [7]. Their argument scheme is an extension to Walton's *sufficient condition scheme for practical reasoning* [8], and follows his method of treating such schemes as presumptive justification. His account views an argument scheme as embodying a presumption in favour of the conclusion, where presumptions are tested by posing critical questions associated with the scheme. In order for the presumption to stand, satisfactory answers must be given to any such questions that are posed in the given situation. Atkinson *et al's* extended scheme, called AS1 and given below, makes Walton's notion of a goal more explicit:

AS1 In the current circumstances R,
we should perform action A,
to achieve new circumstances S,
which will realise some goal G,
which will promote some value V.

In this scheme the notion of a goal has been separated into three distinct elements: states of affairs (the effects of actions), goals (the desired features in those states of affairs) and values (the reasons why those features are desirable). Thus, values provide subjective reasons as to why states of affairs are desirable or undesirable. Additionally, values relate states of affairs, since a given state of affairs may be desirable through promoting several values, and a given value can be promoted by several states of affairs.

Instantiations of argument scheme AS1 provide *prima facie* justifications of proposals for action. Associated with this scheme are sixteen different critical questions that challenge the presumptions in instantiations of AS1. These critical questions are:

CQ1: Are the believed circumstances true?
CQ2: Assuming the circumstances, does the action have the stated consequences?
CQ3: Assuming the circumstances and that the action has the stated consequences, will the action bring about the desired goal?
CQ4: Does the goal realise the value stated?
CQ5: Are there alternative ways of realising the same consequences?
CQ6: Are there alternative ways of realising the same goal?
CQ7: Are there alternative ways of promoting the same value?
CQ8: Does doing the action have a side effect which demotes the value?
CQ9: Does doing the action have a side effect which demotes some other value?
CQ10: Does doing the action promote some other value?
CQ11: Does doing the action preclude some other action which would promote some other value?
CQ12: Are the circumstances as described possible?
CQ13: Is the action possible?
CQ14: Are the consequences as described possible?
CQ15: Can the desired goal be realised?
CQ16: Is the value indeed a legitimate value?

Given this argument scheme and critical questions, debates can then take place between dialogue participants whereby one party attempts to justify a particular action, and another party attempts to present persuasive reasons as to why elements of the justification may not hold or could be improved. It is this structure for debate that forms the underlying model of the PARMENIDES system. In the prototypical version a justification upholding the action of invading Iraq is presented to users of the system in the form of argument scheme AS1. Users are then led in a structured fashion through as series of web pages that pose the appropriate critical questions to determine which parts of the justification the users agree or disagree with. Once a critique has been given regarding the initial justification for action, users are then given the opportunity to state their own full justification of any action they believe should be proposed, regarding the topic in question. Users of the system are not aware (and have no need to be aware) of the underlying structure for argument representation but nevertheless, this structure is imposed on the information they submit. This enables the collection of information which has been structured in a clear and unambiguous fashion from a system which does not require users to gain specialist knowledge before being able to use the tool. All responses given by users are written to a back-end database so that information as to which points of the argument are more strongly supported than others can be gathered. The original proponent of the action, i.e., the Government, can then analyse the information gathered to review public support of its case and perhaps revise or change its justification to make the policy more amenable to public support.

This brief description of the PARMENIDES system is intended as an overview of the tool and it is described in more detail in [6]. We now briefly describe how the argument scheme and critical questions discussed in this section can be employed in an alternative application making use of autonomous software agents.

3. Reasoning About Action Using Autonomous Agents

In [9] Atkinson *et al.* describe how their argument scheme and critical questions can be transformed into a computational account for use in software systems consisting of autonomous agents based upon the popular belief-desire-intention (BDI) architecture. They provide formal definitions that specify pre-conditions for when an agent can construct a position based upon its beliefs, the actions available for performance, the agent's desires, and its values. As standard BDI architectures do not incorporate values, in [9] an account has been given that extends the architecture to include values, which provide justifications for the agent's choice of intentions, based upon its beliefs and desires. A full set of pre-conditions is specified, which when satisfied allow agents to attack a justification for action by posing any of the critical questions against the position. The output of this process is a set of presumptive arguments[1] plus attacks on them. Resolution of a chosen course of action is then done by organising the arguments and attacks into Value-Based Argumentation Frameworks (VAFs) [10], which provide an extension to Dung's Argumentation Frameworks (AFs) [11] to accommodate different audiences with different values and interests. Within a VAF, which arguments are accepted depends on the ranking that the audience (characterised by a particular preference ordering on the values) to which they are addressed gives to the purposes motivating the argument. As in Dung's AFs, the key elements in a VAF are the preferred extensions (PEs), which provide the maximal consistent set of conflict-free arguments, relative to a particular audience [10].

To demonstrate this approach Atkinson *et al.* have provided an example application in [9]. In this example they provide a reconstruction of the arguments involved in a well known legal case from property law and they show how BDI agents can reason about the justified course of action, in accordance with the above method. In the next section we show how a link can be provided between PARMENIDES and the method described above. This link is intended to show how computer support based on argumentation can be used to aid the democratic debating process, whilst accounting for differing opinions.

4. Integrating the Approaches

Given that the two systems described above are based upon the same model of argument, there is an obvious link that can be exploited between them, as we will demonstrate now.

The purpose of the PARMENIDES system is to gather public opinions regarding the justification of proposed government actions. This could potentially mean that large amounts of data are received and stored by the system and it would be useful to have a mechanism to analyse and reason about the data. The use of software agents can serve this purpose.

The database that records the information submitted through PARMENIDES stores all the critiques and counter proposals supplied by members of the public. Any such counter proposal offering a justification for action is decomposed and stored as individual entries that record each of the elements of the justification that comprise an instantiation of argument scheme AS1, i.e., the circumstances believed to be true, the action proposed given these circumstances, the consequences of performing the action that include the

[1] It is assumed in [9] that these arguments will be represented in some suitable formal logic, such as propositional logic, amenable to reasoning by a software agent.

goal of the action, and, the value promoted through achievement of this goal. Given this information, it is then possible to determine different audiences, based upon their value subscriptions, and thus ascertain the acceptability and popularity of each action suggested. An example to illustrate this is given below.

4.1. Example

On entering the PARMENIDES system, the user is presented with the Government's (hypothetical) justification for invading Iraq. This justification is as follows:

- In the current situation: Saddam has weapons of mass destruction (WMD), Saddam will not disarm voluntarily, Saddam is running an oppressive regime, Saddam is defying the UN, Saddam is a threat to his neighbours.
- The action we should take is: invade Iraq.
- Invading Iraq will: Remove the WMD, Restore democracy to Iraq, Assert the authority of the UN, Remove the threat Saddam poses to his neighbours, Cause military casualties, Cause civilian casualties.
- This will achieve: Removing WMD will promote world security, Restoring democracy will promote human rights.

As two values are involved in this justification we can split the argument into two separate justifications: one based on the presence of WMD whereby the action of invading will get rid of the WMD, promoting the value 'world security', and, one based on the existence of an oppressive regime whereby invading will dispel the regime, promoting the value 'human rights'. We shall call these two arguments Arg1 and Arg2 respectively. We are then able to take the individual elements of each justification and instantiate the beliefs, desires, goals and values of a value-enhanced BDI agent (in accordance with the formal pre-conditions described in [9]) to represent the views expressed in these justifications[2]. For convenience we will use a separate BDI agent to represent each perspective in this example. Now, returning to the PARMENIDES system, suppose that a particular user disagrees with the justification given in Arg1. Such a disagreement would be revealed in the summary of the responses of the user's critique that is displayed when he has been questioned about his views regarding each element of the justification. A textual excerpt from such a summary, showing the user's opinion of the circumstances, as displayed by PARMENIDES is given below:

- You *disagree* that Saddam has WMD,
- You *disagree* that Saddam will not disarm involuntarily,
- You *agree* that Saddam is running an oppressive regime,
- You *disagree* that Saddam is defying the UN
- You *agree* that Saddam is a threat to his neighbours.

As an example, if we examine the first item on the list we can see that this particular user believes that Saddam does not possess WMD, i.e., the user disagrees with the description of the current situation. In critiquing this element the user (without knowing or needing to know) is posing critical question CQ1 and we shall call this attack on the

[2]Due to space restrictions we assume that the pre-conditions for instantiating the agents are met and we do not provide specific details of this here. Detailed examples of how agents are instantiated can be found in [9].

justification 'Attack1'[3]. In order to construct the appropriate VAF to represent this attack, we need to identify the value endorsed by this argument. As the attack represents a disagreement as to what the facts of the situation are, we associate this argument with the value 'opinion'. Thus, the critical question posed by this attack isolates the contentious element of the justification that requires clarification, whilst recognising that this is relative to an *opinion* of a particular opponent. This value would initially be ranked as a weak argument against the justification, but it could gain strength were more users shown to have the same opinion. If a general consensus emerged that a particular element was seen as unjustifiable in the opinion of the public, then the Government may be persuaded to act upon the perceived disputable point, e.g., by clarifying the facts or altering the policy.

We can now instantiate a BDI agent that holds the belief manifest in the attack described above, i.e., that there are no WMD. If we now view the arguments considered so far as a VAF, we have the situation shown in Figure 1:

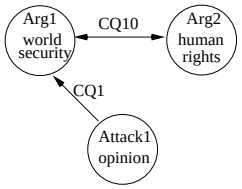

Figure 1. VAF with an attack on a justification.

The VAF in Figure 1 has nodes to represent the two arguments promoting different values and it also shows the attack on Arg1 posed by CQ1 (and note that the other critiques given in the list could also be treated in the same manner). Note also that the VAF shows an attack between Arg1 and Arg2 through the use of CQ10 to point out that although both arguments endorse the same action, they each promote different values. This distinction places importance upon the *justification* that each argument offers in support of the action. The reason these arguments are then seen to attack each other is that each sees the other's justification as being less acceptable. The importance of this point can be seen through the criticism levelled at the British Government who ostensibly invaded Iraq to remove WMD, while critics argued that their motives were actually regime change, illegal under international law. Thus, in addition to deciding which action to execute, deciding upon the most acceptable justification for an action is also an important part of practical reasoning. This point is also demonstrated in other domains, such as the legal one where the justification of actions has consequences for making future judgments.

Returning now to the example, suppose the PARMENIDES user has critiqued the original justification and has also gone on to offer an alternative action plus justification. Such an alternative, which we will call Arg3, might be recorded as follows:

- In the current situation: we believe Saddam may have WMD,
- The action we should take is: give weapons inspectors more time to investigate,
- This will: clarify whether the WMD claim is true or not,
- This will achieve: public trust in the facts.

[3]Note that in all the VAFs presented here 'Arg' is used to denote instantiations of AS1 (that may or may not arise through posing critical questions) and this is distinguished from 'Attack' which is used to denote an argument that poses a critical question but does not instantiate AS1. Thus attacks are solely negative, whereas arguments also propose an action.

The PARMENIDES database would record each of the following: the facts about the situation the user believes to be the case, the action proposed given these facts, the consequences of these facts, and the reasons (values) as to why these consequences are desirable. Such a justification is offering an alternative action, incompatible with the original action, which promotes some other value and thus it is posing critical question CQ11. We are then able to instantiate another BDI agent with the beliefs, desires and value cited in the above justification for action. The VAF showing the addition of this argument is given in Figure 2:

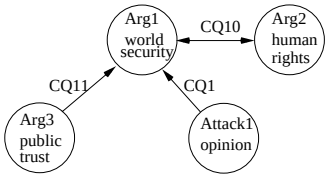

Figure 2. VAF with argument promoting a different value.

In the above VAF the attack of CQ11 on Arg1 would succeed for any audience that ranks the value 'public trust' higher than the value 'world security'. Attack1 would only succeed in defeating Arg1 if it were shown to be an opinion expressed by a sufficiently large number of users, according to a set threshold. As yet, Arg2 has no further attackers so the action of invasion, for the reasons specified in Arg2, could still be justifiable. However, submissions to PARMENIDES may reveal some critiques and counter proposals for the justification of Arg2. Again, consider a sample summary of a user's critique from the PARMENIDES database, this time concerning the consequences of the action:

You believe that invading Iraq will achieve the following:

- Remove the WMD: *Yes*,
- Restore democracy in Iraq: *No*,
- Assert the authority of the UN: *No*,
- Remove the threat that Saddam poses to his neighbours: *Yes*.
- Cause military casualties: *Yes*,
- Cause civilian casualties: *Yes*.

If we examine the second item on the list we can see that this particular user believes that invading Iraq will not restore democracy to the country, i.e., he disagrees with the consequences of the action. This critique poses critical question CQ2 and we shall call this attack on the justification 'Attack2'. As in the case of Attack1, Attack2 will also take the value 'opinion'. So, we can instantiate another BDI agent that holds this belief.

After having given his critique, a user with such views may also propose an alternative position on the matter, such as the example one given below:

- In the current situation: Saddam is running an oppressive regime, Saddam is violating human rights,
- The action we should take is: wait for a second UN resolution on the matter,
- This will mean: unjustified military intervention is not required,
- This will achieve: respect for international law.

As this justification is offering an alternative action, incompatible with the original action, which promotes some other value, it is again posing critical question CQ11. We

will call this Arg4 and we can use another BDI agent to represent this view. Both Attack2 and Arg4 can now be added to the VAF, as shown in Figure 3.

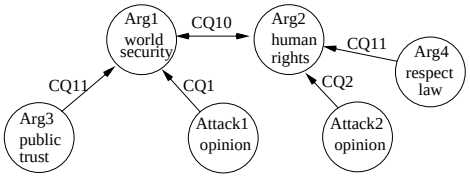

Figure 3. VAF with attacks on Arg2.

In the above scenario the attack of CQ11 on Arg2 would succeed for any audience that ranks the value 'respect for international law' higher than the value 'human rights' (as used in relation to the specific argument). Attack2 would only succeed in defeating Arg2 if it were shown to be an opinion expressed by a sufficiently large number of users.

We have shown how both original justifications can be subject to attack through users' critiques, though there are of course further attacks that could be posed against the original justifications: the attacks discussed this far are intended to show a few examples of how the position can be critiqued. In order to give some structure and analysis to the data submitted to PARMENIDES, all critiques and alternative proposals would need to be represented as VAFs. This would enable the Government to uncover any patterns in the data showing which parts of the justification are mostly frequently disagreed with, and segment the population according to their values. For example, critiques from multiple users may reveal that CQ1 is consistently being posed to disagree with the statement 'Saddam has WMD'. In such a case, the proponents of the original justification (the Government) may then try to clarify their reasons for endorsing this point, i.e., providing information on sources and their trustworthiness. Further critiques may reveal, for example, that CQ9 is consistently used to introduce arguments stating that other values have not been considered by the Government and these values are important to members of the public. In this case the Government would have to provide justification as to why the values they are endorsing are the most important ones concerned in the debate.

4.2. Reasoning About Public Opinions

The previous subsection described how the public's criticisms can be posed against the Government's position on the issue in question. However, to ensure that all opinions have been assessed in relation to each other, the reasoning process should not end here. In the same way that the original justification for invading Iraq was subject to critique, so the user-supplied arguments should also be subject to the same method of critical questioning. The PARMENIDES system currently does not provide a facility by which users can critically assess each other's views, though such an extension is desirable and would seem feasible to implement. However, it is currently possible to examine all views supplied and use the method described in the previous section to show how views between users may conflict. We now provide a short example of this.

If we examine Figure 3 we can see that it contains Arg3. This argument was constructed from an alternative position to the original justification, as supplied by a user. There are numerous ways in which this could be attacked. For example, the original proponent could counter that the goal of verifying whether Saddam has WMD could be met

through the alternative action of consulting an existing dossier profiling Iraq's WMD. This could instantiate AS1 with Arg5 as follows:

- In the current situation: we believe Saddam has WMD,
- The action we should take is: consult the previous dossiers produced by weapons inspectors on Iraq's WMD ,
- This will mean: the WMD claim is verified,
- This will: promote public trust in the facts.

This argument states that there is an alternative action that meets the same goal (verifying the WMD claim), and thus it makes use of critical question CQ6.

Looking to the attacks on Arg2 from Figure 3, we can see that Arg4 is one such attack. Again, this argument was constructed from a user-supplied alternative position and it too could be attacked in numerous ways. For example, the original proponent could counter that the alternative action proposed has side effects which actually demote the value concerned. This could instantiate AS1 with Arg6 as follows:

- In the current situation: Saddam is running an oppressive regime, Saddam is violating human rights,
- The action we should take is: wait for a second UN resolution on the matter,
- This will mean: Saddam is allowed to continue his activities,
- This will: demote respect for international law.

This argument states that the action proposed has unconsidered consequences which actually demote the value in question, ('respect for international law'), and thus it makes use of critical question CQ8. Additionally, there may be further arguments supplied by other users that also attack Arg4. For example, CQ9 could be used to state that the action has consequences which demote some other value, as in the following argument, Arg7:

- In the current situation: Saddam is running an oppressive regime, Saddam is violating human rights,
- The action we should take is: wait for a second UN resolution on the matter,
- This will mean: Saddam's enemies could be vulnerable to attack,
- This will: demote world security.

The above three arguments, Arg5, Arg6 and Arg7, can then be added to the VAF:

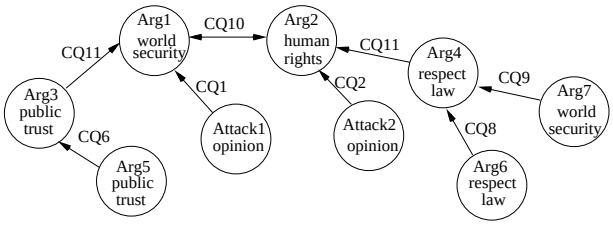

Figure 4. Final VAF.

If the reasoning were to stop here then we can see that for any audience Arg5 defeats Arg3, as the two are motivated by the same value[4]. Arg7 defeats Arg4 for any audience

[4]Following [10], where an argument attacks another argument with the same value in a VAF, the attacker always succeeds.

that ranks the value 'world security' higher than the value 'respect for international law'. If we then consider Arg6, this defeats Arg4 for any audience (again, as the two are motivated by the same value). Nonetheless, the loss of Arg4 does not mean that Arg2 will be reinstated as Arg2 could still be defeated by Attack2. Of course, the new arguments introduced to the VAF will themselves be subject to critique and were further arguments to be introduced to the debate through responses supplied to the PARMENIDES system, then the status of the VAF would need to be updated and re-evaluated accordingly.

The example arguments used here are intended to serve as an illustration of the approach, but in practice we envisage the debate encompassing a much larger range of arguments. Once a sufficiently representative number of views had been submitted to the PARMENIDES system, the Government would then be able to assess the opinions supplied and their relative importance. If the opinions revealed that particular parts of the original justification of the policy in question were viewed as being contentious, then the Government could take measures it deems appropriate to respond to public criticism. This may involve clarification of the facts, release of supporting information, or adjustment to the policy, amongst other things.

5. Related Work

Various mediation systems for deliberative debate have been proposed over the last two decades. We now briefly discuss how the work presented here relates to some similar systems. In particular, we examine the Zeno framework of Gordon and Karacapilidis [4].

Zeno, like PARMENIDES, is a "computer-based discussion forum with particular support for argumentation" [4]. The specific model of argumentation that Zeno is based upon is Rittel's Issue-Based Information System (IBIS) [12]. Zeno's main feature is a type of labelling function to represent arguments so that the relationship of positions regarding a solution to a practical issue can be assessed. From these arguments, a dialectical graph can be constructed showing the pros and cons of the choices available, in order to decide upon a solution to a practical issue. Users are able to express their preferences for particular choices and provide qualifications for these preferences. Zeno's dialectical representation graphs differ from VAFs in a number of ways. Firstly, VAFs solely encapsulate the notion of attack between arguments and as such, say nothing about the 'pros' of arguments. However, within a VAF, an attack on an attack could be construed as a type of supporting argument: if a particular argument is attacked, then a second attack made on the first may re-instate the original argument. In a Dung style AF, the notion of support is captured by considering the acceptability of an argument with reference to a *set* of arguments. An *admissible* set collectively supports all its members against all attacks from outside the set. Such defending arguments are not viewed as 'pros' within a VAF because they are only introduced into a VAF to provide rebuttals to attacks (if such defending arguments do not originally appear in the VAF). In effect, this method is prompting the audience to voice objections to the arguments presented, and any such objections will be included and evaluated as necessary, once identified. This means that only arguments relevant to the debate are included in the evaluation and arguments superfluous to it are avoided. An additional consequence of including supporting arguments in the debate is that they affect the evaluation of the acceptability of arguments. By requiring supporting arguments to be included in order to justify a position, arguments that are not attacked

cannot automatically be presumed acceptable, as they can in a VAF. Again, having this feature in a VAF means that relevant arguments are introduced to the debate only as and when necessary. However, other accounts that make use of supporting arguments have more recently been proposed, such as Amgoud *et al's* argumentation frameworks [13].

Examining now the 'value' component of VAFs, we believe that this provides extra information in the evaluation of the arguments that is not explicitly represented in Zeno. Zeno allows preferences between positions to be expressed, but these preferences are not justified in the subjective manner that is provided by the notion of *an audience* within a VAF. In Zeno's dialectical graphs, positions are regarded more like propositional statements that can be organised into a preference ordering according to the constraints defined in the debate. In VAFs however, such statements are distinguished into goal-value pairs where goal states map onto value(s) promoted by the goals. Thus, preference orderings over values are relative to particular audiences — they are not fixed constraints — and so they provide explanations as to why disagreements occur and what persuasion needs to take place in order for agreement to be reached.

In [14] the Zeno framework has also been compared against other decision support systems, such as McBurney and Parson's Risk Agora System [15]. This particular system was devised to model inquiry dialogues (and in particular, scientific inquiries), though the system is based on a different form of argumentation, namely, a dialogue game. As with most standard dialogue games, the framework specifies locutions that may be uttered by the participants (in accordance with specific pre-conditions), and it also tracks any commitments made by participants throughout the course of the dialogue. However, Risk Agora is not a fully implemented system, thus it does not provide real-time support for debates and it is intended as more of a tool to model the arguments in a debate and the relations between these arguments. Unlike PARMENIDES, it does not concern itself with justifying action through debate, as it is concerned more with inquiry dialogues.

Finally, returning to the eDemocracy domain, there are numerous approaches that have been developed in recent years that advocate the use of web-based discussion boards as a useful way of encouraging and supporting debate. Examples of such approaches can be found in [16,17]. Although such discussion boards can indeed encourage participation and debate, they generally provide no structure to the information gathered. The key advantage that the PARMENIDES system provides over such discussion boards is that it is implemented upon a firm model of argument, which is transparent to the user, but provides structure to the responses submitted. Additionally, the data submitted to PARMENIDES can be further analysed according to the techniques described in this paper. There are, of course, numerous other mediation systems that have been developed to provide support to decision making. However, consideration has been limited to the systems discussed here to illustrate the main merits of the approach presented in this paper, which combines a computational decision support system with current work on argumentation.

6. Concluding Remarks

In this paper we have shown how support can be given to systems for eDemocracy through the use of a current theory of argumentation concerning action. Our approach advocates a method integrating online public debate with current technologies based on autonomous software programs that are intended to provide computer support for rea-

soning about actions. We believe that both the systems described are of value in themselves as they are based upon a defined method of argument representation. Moreover, once integrated we believe that they have the potential to add further value to domains, such as the political one, where reasoning about and justifying actions is crucial.[5]

References

[1] E. Smith and A. Macintosh. E-Voting: powerful symbol of e-democracy. In R. Traunmüller, editor, *EGOV*, LNCS 2739, pages 240–245. Springer, 2003.

[2] J. Argyrakis, S. Gritzalis, and C. Kioulafas. Privacy enhancing technologies: A review. In R. Traunmüller, editor, *EGOV*, LNCS 2739, pages 282–287. Springer, 2003.

[3] A. Prosser, R. Kofler, and R. Krimmer. Deploying electronic democracy for public corporations. In R. Traunmüller, editor, *EGOV*, LNCS 2739, pages 234–239. Springer, 2003.

[4] T. F. Gordon and N. I. Karacapilidis. The Zeno argumentation framework. In *Proc. of the 6th International Conference on AI and Law*, pages 10–18. ACM Press, 1997.

[5] R. Lührs, S. Albrecht, M. Lübcke, and B. Hohberg. How to grow? Online consultation about growth in the city of Hamburg: methods, techniques, success factors. In R. Traunmüller, editor, *EGOV*, LNCS 2739, pages 79–84. Springer, 2003.

[6] K. Atkinson, T. Bench-Capon, and P. McBurney. PARMENIDES: Facilitating democratic debate. In R. Traunmüller, editor, *EGOV*, LNCS 3183, pages 313–316. Springer, 2004.

[7] K. Atkinson, T. Bench-Capon, and P. McBurney. Justifying practical reasoning. In F. Grasso, C. Reed, and G. Carenini, editors, *Proc. of the 4th workshop on Computational Models of Natural Argument*, pages 87–90, Valencia, Spain, 2004.

[8] D. N. Walton. *Argument Schemes for Presumptive Reasoning*. Lawrence Erlbaum Associates, Mahwah, NJ, USA, 1996.

[9] K. Atkinson, T. Bench-Capon, and P. McBurney. Arguing about cases as practical reasoning. In *Proc. of the 10th International Conference on AI and Law*, pages 35–44. ACM Press, 2005.

[10] T. Bench-Capon. Persuasion in practical argument using value based argumentation frameworks. *Journal of Logic and Computation*, 13 3:429–48, 2003.

[11] P. M. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77:321–357, 1995.

[12] H. W. J. Rittel and M. M. Webber. Dilemas in a general theory of planning. *Policy Sciences*, pages 155–169, 1973.

[13] L. Amgoud, C. Cayrol, and M. C. Lagasquie-Schiex. On the bipolarity in argumentation frameworks. In *Proc. of the 10th workshop on Non-Monotonic Reasoning*, pages 1–9, 2004.

[14] W. Rehg, P. McBurney, and S. Parsons. Computer decision support for public argumentation: Assessing deliberative legitimacy. *Artificial Intelligence and Society*, 19(3):203–288, 2005.

[15] P. McBurney and S. Parsons. Risk agoras: Dialectical argumentation for scientific reasoning. In *Proc. of the 16th conference on Uncertainty in AI*, pages 371–379, Stanford, CA, USA, 2000. Morgan Kaufmann.

[16] Z. Masters, A. Macintosh, and E. Smith. Young people and e-democracy: Creating a culture of participation. In R. Traunmüller, editor, *EGOV*, LNCS 3183, pages 15–22. Springer, 2004.

[17] Ø. Sæbø and H. Nilsen. The support for different democracy models by the use of a web-based discussion board. In R. Traunmüller, editor, *EGOV*, LNCS 3183, pages 23–26. Springer, 2004.

[5] A shorter version of this paper is to be presented at the 2006 EGOV conference. I am grateful to both the EGOV reviewers and the COMMA reviewers for their helpful comments and suggestions that have led to improvements in this revised and extended version. I would also like to thank Trevor Bench-Capon and Peter McBurney for their contributions to our joint work on argumentation and practical reasoning.