# Consensus Builder:

## How knowledge sharing can help break political logjams

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### Abstract

Consensus Builder is a vision for an internet application that can organize and facilitate political discussion involving large numbers of participants. Consensus Builder will invite people to speak about what they know and care about. To fully participate, speakers will need to engage in interpretive processes that yield ontological models of statements like those used for the Semantic Web. Analyses of similarities and differences between statements will support listening and exchange of ideas. Semantically informed query and summarization capabilities will aggregate and publish speaker beliefs and facilitate learning from Consensus Builder. One potential early focus for Consensus Builder would be to support a badly needed national discussion about health care. Applications from the organizational to the global levels are also possible.


## 1 Introduction

It is clear that health care in the United States is in need of major system reform. Escalating costs are putting pressure on businesses. Financial failure is looming for major public programs such as Medicaid. Practices that are severely suboptimal from the perspective of the system as a whole are prevalent. For example, insurance policies often neglect preventive treatments for the chronically ill due to classic mechanisms of social dysfunction such as discounting the future and the Prisoner's Dilemma [NYT 1/11/2006].

It is the role and responsibility of government to fix such dysfunctions, but the U. S. government seems to have accumulated complexity to a point where it is incapable of effective reform. For example, the 1992 effort at health reform was killed. More recently, the new Medicare prescription drug benefit is almost ridiculously complex. Even attempts to reduce complexity are being implemented in a self-defeating manner. For example, the National Provider Identifier standard under HIPAA will require every health care provider to have a unique id across all health plans by May 2007 [HIPAA 2004]. From the perspective of system engineering, a straightforward implementation would include the establishment of a national repository to generate identifiers and map from existing ids. Unfortunately, the HIPAA standard was implemented without a national repository, thus burdening health organizations throughout the nation with a tricky problem of decentralized coordination. These organizations are now starting to hire consultants to help them figure out how to deal with the requirement.

If we allow ourselves the freedom to imagine an effective way to formulate health policy, we might imagine a decision-making process something like *nemawashi* as described in Jeff Liker's The Toyota Way [Liker 2004]. *Nemawashi* is a process for building consensus. Everyone affected by a decision gets a chance to speak while others listen. Discussion continues until consensus is achieved or until available time has expired. Thus, making a decision in Toyota typically takes several times longer than at General Motors. But implementation following the decision can proceed rapidly because of confidence that the decision was made correctly.

In The Wisdom of Crowds, James Surowiecki describes another style of effective decision-making [Surowiecki 2004]. When a large and diverse group of people participate in a decision making process and independence of opinion is maintained, then the aggregated results are consistently superior to almost all of the individual decisions.

Today, the internet and the maturation of technology for knowledge sharing are creating an opportunity to build infrastructure that can organize and facilitate constructive political discussion involving large numbers of people. This paper describes *Consensus Builder* – a place on the internet where people will:

- Speak about the things they know and care about
- Listen to what others have to say (if or when they are ready to listen)
- Be counted by a system that continually aggregates and publishes the beliefs of all participants.

Consensus Builder will thus support *nemawashi* on the scale of The Wisdom of Crowds. It will not, however, be a tool for making decisions directly. Rather, Consensus Builder will generate recommendations. The persuasiveness of these recommendations will depend on their quality and the people who have participated in their development.

Consensus Builder is different in several important ways from the visions of deliberative democracy and eParticipation [DDC 2006][Goldman 2004]. First, Consensus Builder does not try to involve people in a variety of public issues, but rather, invites people to speak on the particular issues that they know and care about. The agenda is set by individuals, rather than trying to engage individuals in the government's agenda. Second, Consensus Builder is democratic in the sense of inclusiveness, but not in the sense of equal votes. Some people know more about a problem than others, or have more authority for other reasons. Actually, voting is irrelevant since Consensus Builder does not have power to make decisions directly. Third, interaction in Consensus Builder is asynchronous and more personal in feeling than most of the public forms of public dialog envisioned for national discussions in the style of deliberative democracy.

On the other hand, Consensus Builder is entirely compatible with the goals of eParticipation and deliberative democracy, and could be an important contributor to such movements.

The following sections describe the Speak, Listen, and Be Counted aspects of Consensus Builder. The goal is to convey a sense of what it will be like to participate in Consensus Builder. I am a computer scientist and engineer by profession, but in this paper the treatment of technical computer issues will be kept as light as possible.

## 2 Speak

Speaking to Consensus Builder will involve writing a statement to express beliefs, and engaging in a process of interpretation that helps Consensus Builder create an internal model of the meaning of the statement. Consensus Builder assumes that speakers' desire to participate will lead them to invest the time required for interpretation as long as these requirements are met:

- Speakers must feel that they are being listened to

- The interpretation process must be flexible and rewarding in and of itself.

Figure 1 illustrates speaking to Consensus Builder. The Statement window in the upper left is where the user writes her statement. The color-coding of some of the words shows linkages to the Dialogs window below where Consensus Builder is trying to disambiguate elements of the text. The Simple Speak action button in the Statement window will display a version of the text that strives to use short, simple sentences that describe the essence of the statement, while minimizing subtleties such as rationales, hedging, and other nuances. The advantage of Simple Speak is that it is relatively easy for computers to understand – and sometimes relatively easy for humans to understand as well. More detail about Simple Speak and other aspects of Consensus Builder is available in [Weinstein 2006].

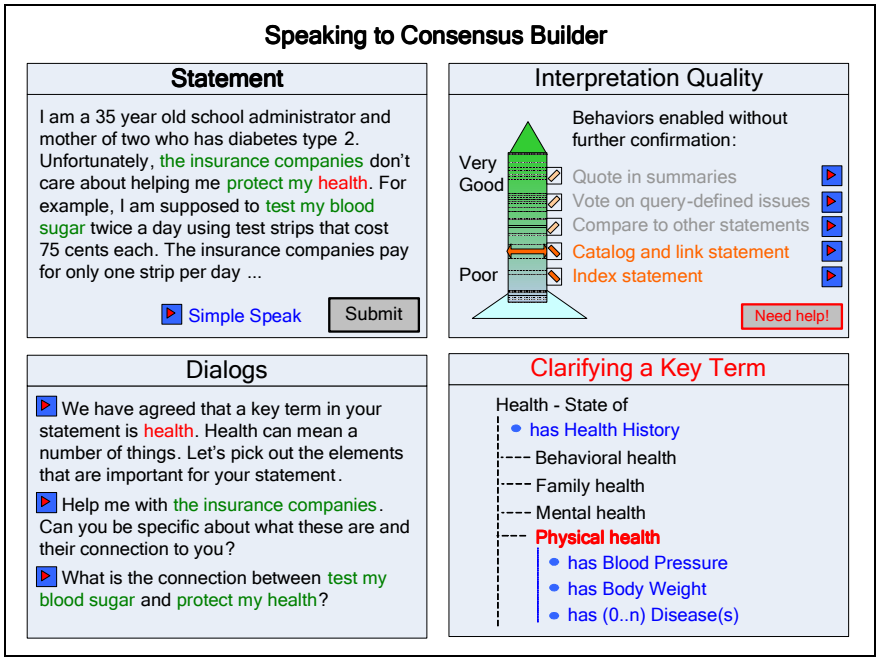


**Figure 1: Speaking and interpretation**

The Dialogs window in the lower left shows a list of questions that Consensus Builder currently has about the meaning of the statement. Each question presents a different path of interaction with Consensus Builder, embodied by a different interpretation device that will show in the window in the lower right. Every path of interaction leads towards better interpretation, but in different ways that may be more or less interesting for the speaker. In general, we say that user interaction with Consensus Builder is *anytime* and *anywhere* because users can provide input when they want to and in a manner that they select.

In Figure 1, earlier interaction has identified the term "health" as a key concept in the text. The concept of health, however, is fairly abstract. There are many dimensions to health. If the user identifies a particular meaning to the system then this will improve the quality of the interpretation and will lead to further useful dialog. In the figure, the user has selected the first item in the Dialogs list and this has caused the window in the lower right to display a tool for Clarifying a Key Term.

The Clarifying a Key Term window shows an extract of a model of health in the sense of a state of being. Internally, Consensus Builder will use a type of model called *description logic ontologies* to represent meanings. Description logic is the technology used by the W3C Semantic Web movement [1] [Daconta et al. 2003]. Ontologies represent concepts as webs of relationships to other concepts. For example, concepts have properties such as attributes and part/whole structure. Properties are themselves represented as concepts. In Figure 1, the concept Physical Health includes properties such as diagnosed diseases, blood pressure, etc.

A very important kind of relation between concepts is inheritance, also called "kind of", generalization/specialization, or subsumption. For example, people are a kind of mammal, which are a kind of animal and so on. Specialized concepts inherit all of the properties of their relatively abstract parents. According to the model in Figure 1, for example, Physical Health inherits the property of having a Health History from its parent concept Health – State of.

Figures 2 and 3 show other examples of interpretation devices that can be used to add precision to the system's understanding of various elements of the speaker's statement. There will be many of these: any diagram or other tool with clear semantics can be useful. The requirement for clear semantics means that each element of the drawing has a particular meaning. For example, the arrows in Figure 2 identify temporal prerequisites, while the arrows in Figure 3 identify causal relations. Consensus Builder will translate most or all of the information expressed by each interpretation device into concepts and relations in ontological models.

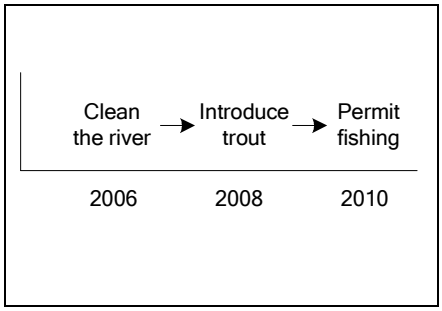


**Figure 2: A plan**

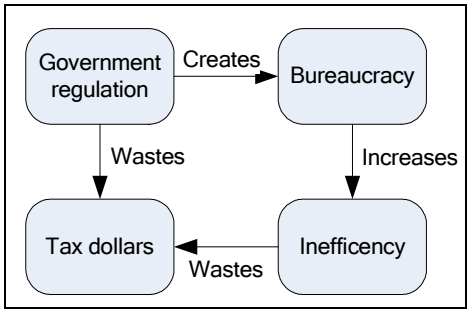


**Figure 3: Causal relations**

The Interpretation Quality window in the upper right of Figure 1 reflects the system's dependence on modeling speaker statements to make Consensus Builder a place to speak, listen, and be counted. Generally, the higher the quality of interpretation achieved, the greater will be the system's willingness to behave in ways that create risk associated with

[1] To understand the Semantic Web, imagine that we could program computers to accurately understand natural language. Internet search engines would then be even more amazingly useful, since queries and responses would be based on the information in phrases and sentences rather than combinations of words. Since we do not yet have accurate natural language understanding in open domains, the Semantic Web proposes that web publishers provide an ontological model with every page that represents its content in a way that computers can reason with. The Semantic Web can thus provide services as if it could do natural language understanding.

possible errors. The following system behaviors, for example, will require increasing degrees of confidence in the interpretation:

- Index the speaker's statement with keyword-based technology similar to that of today's internet search engines.
- Catalog the speaker's statement with explicit hyperlinks that connect the statement and parts of the statement to those of other speakers. This level of automatic cataloging will leverage the semantic precision of the internal ontological model.
- Compare the speaker's statement to other statements to identify similarities and differences (see Section 3).
- Infer from the statement how the participant would want to vote on issues defined by queries (see Section 4).
- Extract text from the speaker's statement for inclusion in summaries that describe the state of consensus building on defined issues (see Section 4).

Each of the system behaviors listed in the Interpretation Quality window in Figure 1 is accompanied by an action button. These buttons invite speakers to provide feedback on tentative conclusions that the system infers on the basis of its current understanding. For example, the system will open new windows that show how the statement will be linked to others; or how the system believes the user would vote on various defined issues. Reasoning about these behaviors works in two directions: if the speaker confirms system conclusions this will raise the system's degree of confidence in its interpretation, while corrections to erroneous conclusions will cause revision of the interpretation.

Systems using artificial intelligence sometimes do not perform quite as well as the designers would like, and it is possible that speakers will sometimes develop a feeling of frustration during the interpretation process. The Interpretation Quality window therefore provides a button where speakers can ask for help from a human agent. Human agents will play an important role in Consensus Builder, filling the gap between the level of intelligence required and the kind of intelligence that can currently be achieved with computers. The system's response to requests for help will depend on the availability of resources and other factors such as the speaker's history with the system.

A variety of human and mixed system/human interventions will be possible along a spectrum that trades off expense and quality of service. For example, if a human agent is available the system could open a text messaging window or an audio-visual connection providing an offer of unrestricted conversation. On the other side of the spectrum, this could be a structured form where speakers register complaints to be processed within a time period that reflects the current backlog, whatever that might be. The system could facilitate efficient handling of such complaints by doing its best to interpret the complaints and generating hypotheses about possible resolutions. In between these extremes, a variety of interventions could be designed to keep speakers positively engaged with the system while minimizing cost. These options could utilize professional staff, trained volunteers, or other untrained speakers – there are many possibilities.

The process of speaking to Consensus Builder described in this section will convey to speakers the feeling that they are being listened to because there will in fact be listening on multiple levels: by the system, by human staff and volunteers, by other participants, and by society as a whole. Meanwhile, the process of interpretation may often be rewarding to speakers in and of itself by helping them clarify their thoughts and feelings.

## 3 Listen

The fundamental requirement for listening in Consensus Builder is to create an atmosphere of mutual respect. The prevalence of negative behaviors in many existing internet forums means that Consensus Builder interactions need to be mediated in a relatively controlled way. Speakers should not be bombarded with requests, flaming must be strongly discouraged, and in general interaction must be structured in a manner that gives speakers the feeling that it is safe to express their opinions.

The key technology supporting listening in Consensus Builder will be the ability to compare models of speaker statements. Model comparison identifies *similarities* and *differences* between statements. The best way to start a political discussion is to explicitly recognize similarities: beliefs that the participants share. Then, attention can be focused on the differences: figuring out which are important and which can be safely ignored or set aside for a later time, and looking for creative ways to reconcile the differences which are most important.

To compare models Consensus Builder will use algorithms for graph matching. In computer science, the term “graph” means a set of vertices connected by edges. Ontological models consist of concepts connected by relations, so the models that Consensus Builder uses to represent speaker statements can be thought of as graphs. Algorithms for graph matching search for the best way to put elements of the graphs into one-to-one correspondence.

Figure 4 illustrates listening in Consensus Builder. For convenience, let us call the person who spoke in Figure 1 of the previous section Carol72. Here, Carol is comparing her statement to that of Chaim54, who also has strong beliefs about the financing of health care in America. Chaim’s statement is colored green, and this color is used to identify Chaim’s beliefs in all of the listening windows.

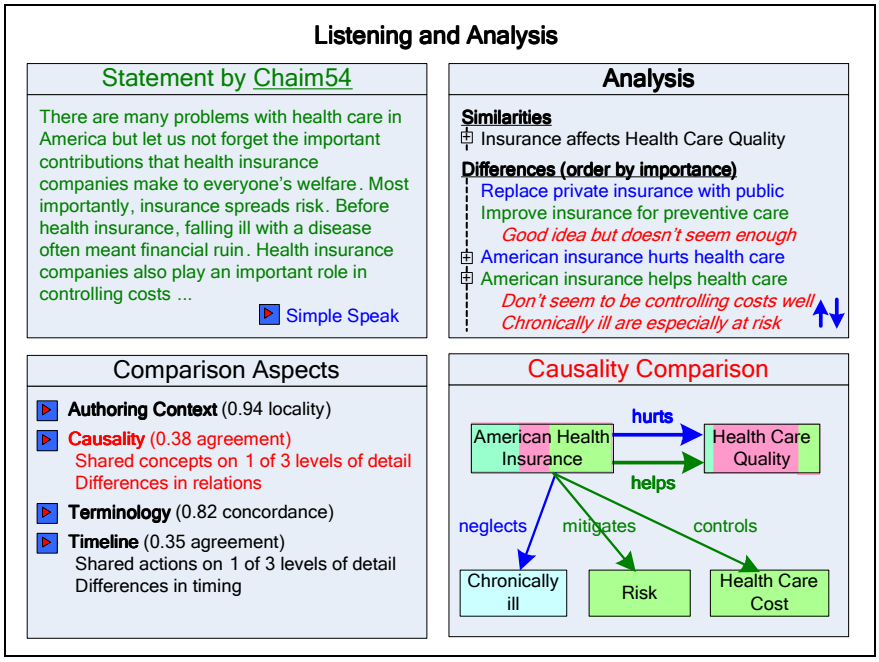


**Figure 4: Listening and analysis**

The lower left window, called Comparison Aspects, provides a list of ways that Carol can select to compare her beliefs to those of Chaim. Each choice opens devices in the lower right window that compare aspects of the two models.

The Causality Comparison selected in Figure 4 overlays causal diagrams developed by Chaim (green) and Carol (blue). The color pink is used to reflect the degree that the concepts in the underlying models share definitional properties.[2] Thus, this visualization lets users see in an easy, natural way where the models are similar and different. In Figure 4, for example, it is clear that Carol and Chaim are more in agreement regarding their ideas about what constitutes Health Care Quality than regarding the effectiveness of American Health Insurance. Differences in the beliefs of Carol and Chaim about the effect of insurance are detailed in relations that are present in either model but not both.

The Analysis window in the upper right is currently the focus of Carol's activity. This window lists similarities and differences between Carol's and Chaim's statements. These can be inspected at different levels of detail. Carol has already spent some time ordering the differences to focus attention on what is really important. She is also adding some comments about the differences (shown in red italics) to help her prepare to write a version of her statement that addresses Chaim's beliefs.

So far our discussion of comparison in Consensus Builder has glossed over a fundamental challenge that reaches to the roots of communication and intelligence: the issue of *semantic heterogeneity*. Formally, semantic heterogeneity refers to the use of terms that are inconsistent (the same term is used to mean different things), redundant (multiple terms mean the same thing), or more generally, that have meanings that overlap

[2] For readers looking at black and white: the rectangles for American Health Insurance and Health Care Quality have three background colors, with blue on the left, pink in the middle, and green on the right.

in ways that can be vague and complex. Informally, the problem is that our use of language is loaded with ambiguity and there is a very large number of ways to say just about anything. As a consequence, if two speakers were to engage with Consensus Builder in processes of interpretation that were independent, the system would not be able to produce the kind of high quality comparison illustrated in Figure 4.

Fortunately, interpretation processes need not be independent at all. One way to think of interpretation is that speakers help Consensus Builder translate their statements to be expressed in terms that are defined by a globally shared ontology. The flaw in this argument, however, is that a global ontology capable of accurately expressing all speakers' views would need to contain millions or billions of definitions. To request speakers to clarify intended meanings in such a massive context would simply not work.

Indeed, to limit interpretation to any set of pre-defined terms would suppress the kind of creativity that we want to encourage. The relationship between language and thought is very close and speakers need to have the freedom to invent new terms if that helps them express their ideas.

Therefore, we are developing an approach to ontologies that we call *Living Ontologies* [Weinstein, Phelps 2006]. Living Ontologies find a productive middle ground between unrestricted use of terminology and enforced adherence to rigid standards. The key strategy for Living Ontologies is to use inheritance to separate similarities from differences. We call the process of maximizing inheritance *model unification*.

Figure 5 illustrates the effect of model unification on models that are specified with shared user interface devices, but that otherwise use unrestricted terminology. The concepts in these "original" models inherit some properties from core concepts that capture the semantics of the shared user interface. Model unification creates a new middle layer of generic concepts that makes similarity previously hidden in community-specific concepts explicit. The overall meaning of the unified models is not changed. For a description of how we accomplish model unification see [Weinstein and Phelps 2006].

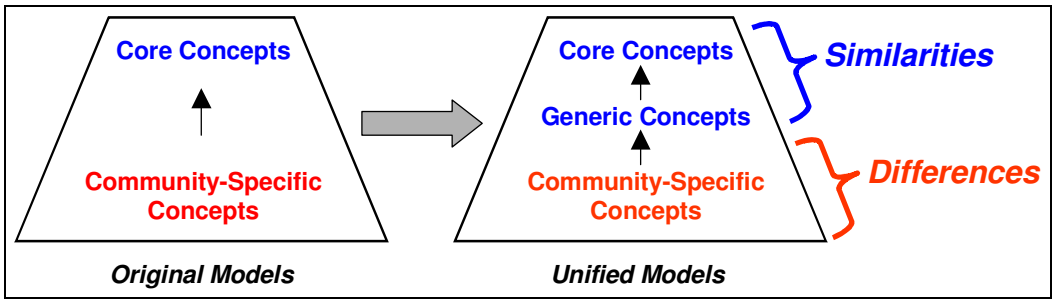


**Figure 5: Before and after model unification**

Model comparison will both require and contribute to an ongoing process of model unification. Generally, speakers from the same community will tend to use the same ontologies. Statements of speakers from communities with little contact, however, will tend to use ontologies that are poorly unified. In this situation, the comparisons generated by Consensus Builder will be weak. If listeners provide feedback on weak comparisons, however, Consensus Builder will use this information to increase the degree of model unification between their respective ontologies, leading to more useful comparisons the next time around. Opening a dialog between separate communities may require dedicated

pioneers willing to delve into terminological details, but subsequent dialogs will be easier.

Thus, listening in Consensus Builder will help to build bridges between diverse communities on multiple levels. This suggests that an important role for volunteers and professional staff may be to spend time editing comparisons of statements from communities that need help to get dialog started. It may even be possible to build bridges between communities that use different languages, since there is no limitation inherent to ontologies that prohibits a mixture of languages.

# 4 Be Counted

This section describes how Consensus Builder can aggregate and publish the beliefs of those who have spoken. Consensus Builder will provide a stage from which individuals can address their community, nation, and the world. The greater the degree to which Consensus Builder empowers individuals, the more people will want to participate. Thus, the goal of the "Be Counted" part of Consensus Builder should be to publish the beliefs of speakers in a manner that is as persuasive and effective as possible.

We must acknowledge, however, that Consensus Builder has no claim to authority. It is tempting but misleading to describe Consensus Builder as the voice of the people – as the equivalent of a super-sophisticated, extra-flexible opinion poll. Decision makers in representative democracies are very sensitive to polls. It will be wonderful if they are also very sensitive to Consensus Builder. Scientifically conducted polls, however, estimate the opinions of the full population within statistically determined confidence intervals. The mathematics of polls is based on randomly selected samples. Consensus Builder violates the requirement for random samples by encouraging people to speak about the issues that matter most to them, and by the self-selection of people who decide to participate. While it might be possible to add scientific polling to Consensus Builder, this might be awkward.

Rather, the persuasive power of Consensus Builder will depend on the quality of its results. The underlying assumption is a belief in human problem solving under conditions of mutual respect and the exchange of ideas. The design of the "Be Counted" part of Consensus Builder should focus on how to enrich and facilitate speaking and listening: in other words, the problem solving process. Thus, Consensus Builder should be a tool for learning.

Figure 6 illustrates some of the capabilities that might be developed to support learning from Consensus Builder. The counts displayed have no basis in data.

The Query window in the upper left shows a query specified as a short sentence in natural language. Queries specified as phrases or sentences carry substantially more information than the lists of words used by internet search engines today. The resulting accuracy of the responses will be substantially improved compared to today's search engines.

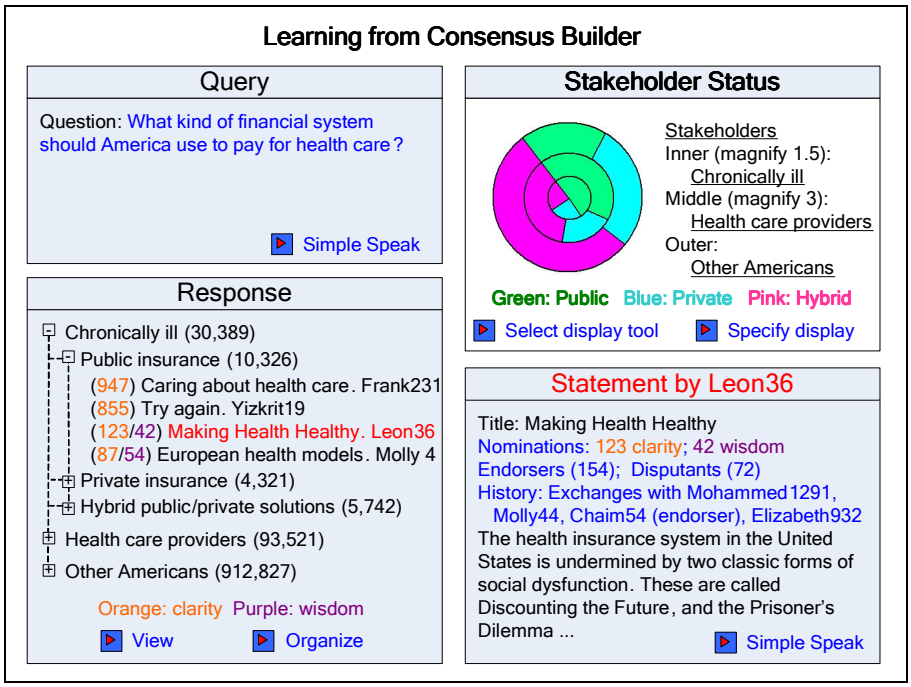


**Figure 6: Learning from Consensus Builder**

The Response window in the lower left of Figure 6 shows how Consensus Builder can use its understanding of speaker statements to organize query responses in flexible and meaningful ways. In the figure, the user has previously used the Organize action to define a categorization of the responses according to metadata provided by the authors (distinguishing Americans who are chronically ill, health care providers, and other Americans), and according to the substance of the statements (whether a public, private, or hybrid financial system is preferred). The numbers in parentheses to the right of each category is the total number of statements that are members of the category. To categorize statements according to their content is essentially to vote on the issue defined by the query – a form of reasoning listed in the Interpretation Quality window of Figure 1 in Section 2.

The numbers in orange and purple associated with statements in the Response window are measures of recognition awarded to these statements by other participants. The design of these measures will be very important for fostering the development of leaders: people who become recognized as speakers for their cause, who are thus well positioned to engage in a process of listening and negotiation. For example, participants may be granted the right to nominate a limited number of statements for recognition of various aspects of quality. Selecting a statement and clicking the View action causes display of the statement in the Statement window in the lower right of Figure 6.

The Statement window in Figure 6 is much as we've seen before, except that metadata describing the statement is displayed along with its text. Here the orange and purple measures are labeled as "clarity" and "wisdom", but the definition of these or other measures of recognition is yet to be determined. Also shown is the number of participants expressing strong agreement with the statement (Endorsers) and strong disagreement (Disputants). Statements that achieve high recognition for quality, many endorsers and

few or zero disputants may be indicative of consensus. It may also be possible for groups of people to write statements collaboratively in the style of [Wikipedia].

The Stakeholder Status window includes a visual summary of beliefs on the issue defined in the Query window, structured according to the organization defined in the Response window. Here, the chronically ill are displayed as the inner circle of stakeholders, while health care providers are the middle ring and other Americans the outer. The area within each ring is colored according to the position taken by the statement regarding the issue defined by the query, and its size is in proportion to the number of statements in each category. This visualization device highlights discrepancies in frequency of beliefs between the layers of stakeholders.

The analyst uses the Specify Display action to set aspects of the visualization that complement the organization of the response. These display decisions will often require subjective judgments. For example, it is not objectively certain that the chronically ill should constitute the inner circle of stakeholders. Consensus Builder displays should thus be evaluated critically as is appropriate for any media content.

The Select Display Tool action will provide a menu of devices for visualizing various kinds of analyses. One way to use these results will be to copy and paste them into new statements spoken to Consensus Builder. This will be one way in which understanding created using Consensus Builder will enrich further discussion.

Thus, Consensus Builder can become a powerful tool for learning about issues as experienced by all stakeholders. In the process of helping participants learn about the beliefs of others, Consensus Builder will fulfill its promise to all speakers that they will be counted.

# 5 Discussion

This section briefly discusses two salient issues.

## 5.1 Technical Feasibility

Implementing Consensus Builder will require currently available technology for knowledge representation plus some creative and disciplined programming. There are technical difficulties that need to be worked through. For example, description logic is insufficiently expressive to capture the full meaning of second order relations such as “believe”, “should”, and indicators of uncertainty such as “may”. This will result in a certain amount of complexity in the computer code for interpretation and comparisons.

In comparison to the Semantic Web in general, however, Consensus Builder is a relatively modest endeavor from a technical point of view. In the Semantic Web, anyone can create a new ontology from scratch. In Consensus Builder, ontological models are generated by a single system with core ontologies shared by all, guaranteeing some basis for model unification. Also, Consensus Builder provides a well defined, relatively tidy task context compared to the Semantic Web, which seeks to model most or all of human knowledge.

### 5.2 Trust

The overall thrust of Consensus Builder is strongly democratic since its fundamental objective is to provide a way for people to participate in public political discourse. There is a possibility, however, that the system could be manipulated.

To create and protect the trust essential for Consensus Builder to succeed, Consensus Builder must be:

- Non-partisan
- Non-profit
- Open source.

Open source means that the computer code that implements Consensus Builder should be available to the public.

## 6 Conclusions

This paper has described a vision for an internet application that can organize and facilitate political dialog involving large numbers of participants. The motivating premise is that high quality solutions will emerge from a process where knowledge is shared and discussed in an atmosphere of creative negotiation. Consensus Builder itself has no authority to make decisions directly (which may help to reduce the vitriol that often accompanies political debate). Rather, Consensus Builder is a tool for generating recommendations whose persuasiveness is determined by the quality and relevance of their content, and by the political will generated in the process of building consensus.

Health care in the United States is particularly attractive as an initial focus for Consensus Builder. This is because:

- Health care affects everybody
- There is a clear need for change
- Health as a topic brings out the cooperative and caring nature of people.

There is no guarantee that a nationwide discussion on health will produce consensus, or even a small set of clearly differentiated ideas. It would be somewhat disappointing if Consensus Builder yields an inconclusive mass of ideas and opinions (at least it would be a well-organized mass thanks to the classification capability of description logic).

Sociologists will be needed to play important roles in Consensus Builder, namely, to design and guide consensus building processes that work. There will be several ways to contribute. As designers of Consensus Builder, serious thought needs to be given to features that will shape the progress of discussions such as criteria used to suggest listening encounters, the definition of indicators of recognition, and so on. As participants in Consensus Builder, sociologists can contribute insightful analyses of the state of issue discussions that may lead to superior solutions. And as human agents working behind the scenes, sociologists will be uniquely qualified to set priorities and otherwise guide efforts to further constructive discourse in ways consistent with the core principles of non-partisanship and mutual respect.

Consensus Builder will provide wonderful opportunities to study social problems. Wide participation in Consensus Builder will generate large knowledge bases of rich qualitative data, with associated metadata and models that permit powerful analytical capabilities such as those described in the Be Counted section of this paper. Participant self-selection and the lack of random sampling mean that it will not be easy to describe the whole population in a statistically rigorous way. Populations of participants in various discussions, however, may themselves be worthy of study. This will be particularly true from the point of view of increasing understanding about how to build consensus. This knowledge can then be applied to further increase the effectiveness of Consensus Builder for developing wise recommendations.

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