

Crystallizing Local Political Knowledge for Informed Public Participation

Guoray Cai^(✉), Feng Sun, and Jessica Kropczynski

College of Information Sciences and Technology,
Penn State University, University Park, PA, USA
{cai, fzs122, jkropczynski}@ist.psu.edu

Abstract. Municipal governments often struggle to inform and engage citizens around local issues. Due to complexities of local politics and the diverse expressions in public and private spheres, citizens face a huge information barrier towards meaningful participation. To overcome such barrier, we explore a solution to provide citizens with clear, useful, and trustworthy information. We describe a framework for accomplishing this goal through issue-based knowledge crystallization. In order to put this framework into test, we devised *Community Issue Review* (CIR) as a concrete process for crystallizing local political knowledge. CIR is a structured deliberative process that use a citizen panel to conduct analysis of data relevant to a pending issue. We describe CIR in three aspects of its functions: *institutional design*, *deliberative process*, and *productive outcome*. Three special characteristics of CIR are emphasized: (1) fully embedded within local decision-making context; (2) hybrid (face-to-face and online) deliberation; (3) facilitation on collaborative decision-analysis. We present the iterative design of the CIR process and the lessons learned from field practices in a local community.

Keywords: Civic engagement · eParticipation · Online deliberation

1 Introduction

Democracy empowers the public through their influence on political decisions [7]. Policy issues in local governments are complex and contentious. While electronic government applications provide opportunities for broad participation, meaningful participation of public decision-making requires the ability of the participants to produce reasonable, well-informed opinion in light of discussion, new information, and claims made by fellow participants [2]. Such ability is often hindered by the lack of exposure to a diverse marketplace of ideas [16]. Since most citizens are not experts on public issues, their ability to contribute to public decision making is vitally based on comprehending the necessary information from media and others [15]. Informing the public with adequate knowledge about policy issues is hard for many reasons. Understanding complex policy issues requires synthesizing three types of knowledge. *First*, the public needs to be informed by

good science that characterizes the potential consequences (benefits and risks) of any policy option [3]. *Second*, it must give all stakeholders an opportunity to express their social, economic, and ethical concerns. *Third*, it must be informed by understanding the institutional, political, legal, and operational contexts of decision-making. These knowledge can be buried in a plethora of on-line and off-line information sources.

Recent proliferation of on-line participation platforms have significantly enriched the channels of expressing opinions on public matters [6], but at the same time, it creates information glut to citizens' use. Typically, information about a policy issue is buried in new media, community forums, government web pages, documents, and reports, community meeting notes, as well as in the minds of experts, residents, and other stakeholders. Messages in these data are poorly framed, piece-wise, difficult to connect, redundant, and inconsistent. Unfortunately, interpreting and synthesizing such data are challenging tasks that few citizens are prepared to deal with. This problem has by far received little attention, and no practical solution has been proposed. This problem is well recognized in the literature of deliberative democracy [9] and policy communication studies [18]. Elliman et al. [5] emphasized that the most fundamental barrier in public deliberations is the large amount of heterogeneous knowledge that needs to be made explicit in different formats at different stages of public opinion formation.

To address this problem of the wide dispersion of local knowledge, various computer-mediated systems and data mining techniques have been developed to automatically discover and aggregate diverse sources. Kavanaugh et al. [11] developed a *Virtual Town Square (VTS)*, a local news aggregator, that affords civic interaction through tagging, commenting, and sharing insights. However, even data are aggregated, they may still be too large for the public to make sense of them. Automated textual analysis tools have been used to detect important messages and alert analysts. Hagen et al. [10] automatically analyzed thousands of petitions to generate more concise reports for decision makers. Topic modeling methods [20] are useful here because it summarizes the most popular topics that appear news articles and blogs and representing them together in an intuitive way. Automated methods (as mentioned above) can improve the accessibility of community information sources. However, they are far from providing actionable knowledge to citizens. Useful knowledge has to be discovered from the data and be contextualized for certain tasks [19]. It is cognitively difficult and time-consuming for a person to make sense of large and complex data.

This paper argues for the need to communicate policy relevant knowledge more effectively to the public in order to maximize the chance of their meaningful participation with the constraints of the limited cognitive capacity and attentional resources. This need can be met by incorporating an explicit phase of "knowledge crystallization" before engaging the broader public to elicit their policy preferences. We present a conceptual framework for structuring knowledge crystallization tasks (Sect. 2). Following this framework, we propose a concrete process, *community issue review (CIR)*, that can be practiced as a policy

knowledge co-creation tool in a variety of policy-decision contexts (Sect. 3). We implemented and used CIR in evaluating a real community proposal and observed the positive impact to the level of engagement (Sects. 4 and 5). In the same time, we received feedback on how the CIR process and the supporting technology can be improved and be made more flexible to support best practices (Sect. 6).

2 Issue-Based Knowledge Crystallization for Democratic Deliberation

Our research addresses the need of crystallizing knowledge to overcome the information glut experienced by local communities when residents are called for participating public deliberation on a pending policy issue or proposal for action. Instead of pouring a large amount of messy data to all the members of a local community, our solution is to crystallize the knowledge about the policy issue into a set of clearly stated findings, called Citizen’s Statements, that is amenable to human mental processing [17] by the lay public.

We define knowledge crystallization as a process that aims to produce a most insightful and compact description of the relevant content of a data set for a given task without removing crucial information. Examples of knowledge crystallization tasks include writing a business intelligence newsletter, reporting on the analysis of a business strategic management practice, or a scientist writing a literature review article [1]. Issue-based Knowledge crystallization (IBKC) takes all the data that we can collect about a particular public issue, and puts them through a systematic process of distilling relevant nuggets, purifying, abstracting, and compacting to create a best and most accessible “form” of knowledge for human consumption.

Crystallization is a metaphor borrowed from chemical engineering, where the goal of crystallization is to produce a highly purified and ordered crystal lattice from raw materials through the processes of purification and condensation. We use the concept of *knowledge crystals* to represent a form of knowledge that is highly purified, compact, succinct, structured, and solid.

An overview of the knowledge crystallization process is shown in Fig. 1. The rectangular boxes represent entities involved in the process. The arrows represent flow relationships among them. This process has four small loops and has one set of loops that cycle around knowledge evaporation and another that cycles around knowledge condensation, with plenty of interaction between these. This process is guided by a knowledge schema that reflects the structure of inquiries used by the decision-makers. A bigger rectangular task wraps the entire process and serves as the context.

3 Community Issue Review

Community Issue Review (CIR) is a community-level panel-based deliberation process for crystallizing knowledge about a pending community issue [12].

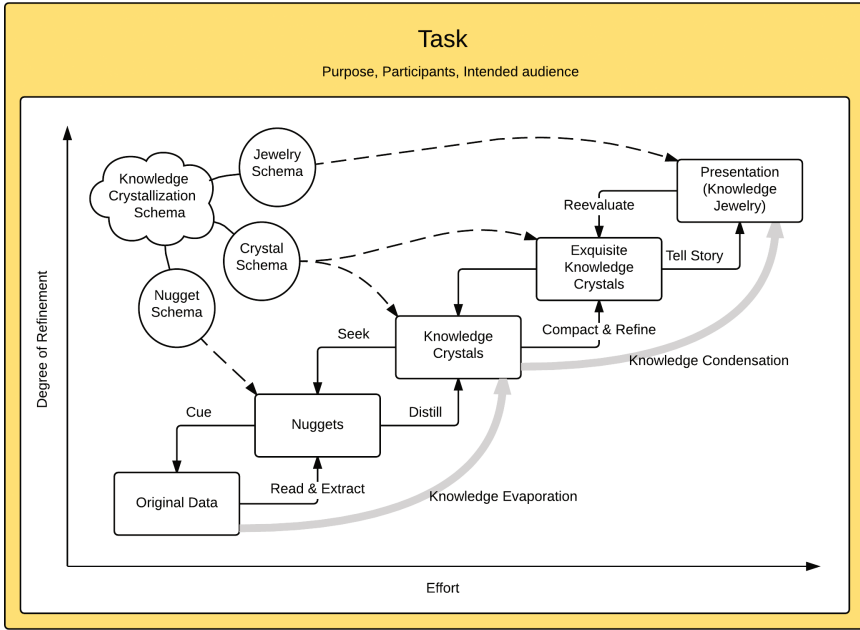


Fig. 1. The framework for issue-based knowledge crystallization

It is specially tailored to the need of informing the public on local policy issues. CIR guides a group of panelists to review an issue relevant to the community in-depth through a multi-day public review process. Panelists are either randomly or strategically selected from a community. As representatives of a community, panelists are given access to a large amount of data from various sources concerning a given issue. CIR aims to generate an informative briefing of the issue, called *Citizens' Statements*, to provide the community with insights concerning the issue so that everyone in the community is able to form opinions effectively and efficiently.

CIR can be conducted in a purely face to face environment. However, citizens have their daily work and can only allocate limited time (especially daytime) and effort for CIR. In our experimental studies we choose to blend online and face-to-face activities. There are two face-to-face meetings on the first and last days respectively, and the panel works online during the time in between. The whole process may last about ten days to two weeks depending on the complexity of the issue. The expected outcome of CIR is a set of *Citizens' Statements*, including 10 findings, 5 pros, and 5 cons. The slots associated with the 20 statements are allocated in advance and can be assigned with customized labels for easier reference. Each category is equipped with a progress bar that shows the current working process of categorization.

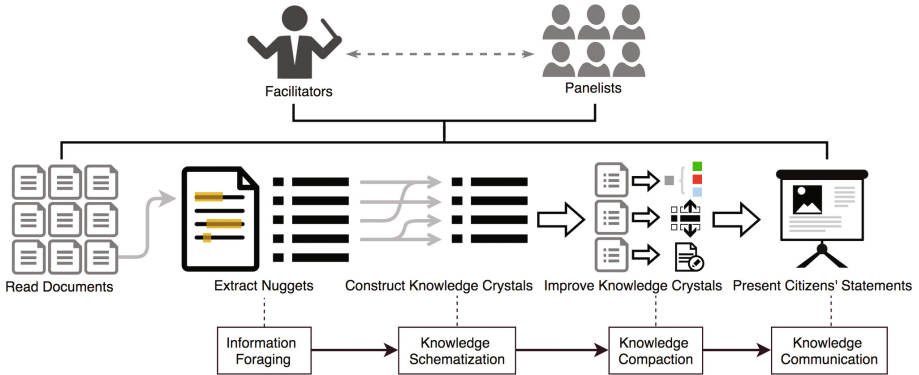


Fig. 2. The overview of community issue review as a knowledge crystallization implementation

In the rest of the section, we describe the phases and relevant activities in a CIR process. We will also identify the challenges users may face and show how technical support can contribute.

3.1 Preparation

Recruiting Citizen Panel. One important design question is: *who should be the part of the CIR panel for crystallizing the community knowledge?* We choose to use a small group of citizens as the panel. By bringing in diverse perspectives and skills, we can expect CIR to perform an in-depth analysis in a deliberative manner. Since the outcome of the CIR is to be used by citizens in a community, using peer citizens in CIR ensures a degree of trust by other citizens. We follow the work of a small group deliberative democracy process [8], which selects panelist from the relevant population through stratified random sampling as representatives.

Assemble information package for a pending issue. In an ideal world, input to CIR should be all the information that can be found about a community issue. In reality, we use a team of undergraduate researchers to collect documents from government websites, public media, experts and senior citizen advisors to compile an information package to be distributed to each panelist. We also identify and invite subject matter experts and government officials to review and supplement the package to ensure completeness. The contents usually include neutral descriptions of proposals/ordinances and evidences for/against a policy proposal. Other than published reports, websites, and news articles, the document collection also contains interviews with subject matter experts and their written statements. During the CIR process, panelists are allowed to add more materials through a request.

Issue Briefing. Before moving to the first phase, the panelists will get together and learn about the community issue through a face-to-face meeting. During this

meeting, the CIR panel members are charged with investigating a policy issue that is usually complex and controversial. In the same time, they will pick up an information package with all the details about CIR process, data to be analyzed and the intended outcome. They will have a chance to get to know each other as collaborators. Panelists will also receive a training on how to use the online deliberation system, GeoDeliberator. They can also communicate with experts directly to resolve quick questions.

3.2 Phase I: Extract Information Nugget

Nugget Extraction in CIR is aimed at reliably recognizing and collecting all data segments (or nuggets) relevant to the pending issue. Doing a good job in this phase is the prerequisite for subsequent tasks of knowledge crystal formation, refinement, and compaction. During this first phase of CIR, panelists work asynchronously online to gather information nuggets relevant to a policy issue. The document view contains a collection of documents, plus a table of contents for easy navigation. These documents are identical to those included in the information package. When a panelist recognizes a nugget in a document, and he/she can extract nuggets by selecting a piece of text judged as relevant to one or more theme. Once a segment of text is selected, it will be highlighted with yellow color and be prompted to assign this information nugget to a theme. All the themes are listed on the top and a detailed explanation will be provided when placing cursor over each theme icon.

All the extracted nuggets are collected into the *nugget list*. Nugget List view is actively linked to the Document View, allowing panelists to trace back to where a nugget originates in the document. Capturing the relationship between nugget and its origin in documents effectively makes it possible to replay and review the analytical process later on [14].

3.3 Phase II: Assemble and Improve Claims

The purpose of *Claim Assembly* in CIR is to transform collected information nuggets into claims, which should be relatively well-written, self-contained, and based on facts and evidence. There are two kinds of claims: findings (objective facts) and opinions (facts with implicit position). The opinions can be further decomposed into two categories: substantiate and refute, depending on the position. A claim is informed by one or more information nuggets. Claims can be further elaborated and improved through adding more information nuggets, removing irrelevant or unimportant contents, rewording, merging several claims or splitting a claim.

A new claim can be created by clicking + button on the top of the claim list. Once a new claim is created, the view automatically switches to the claim workspace where one can write the claim text and cite any nuggets (by clicking the “adopt” button next to a nugget) that contribute to the claim. By adopting nuggets to a claim, a semantic link is established between the selected nuggets

and the current claim. In addition to editing the claim directly, panelists are also encouraged to leave comments to others and discuss the claim.

3.4 Phase III: Generate Statements

Phase III is to refine the statements by making them more compact, defensible, and understandable. This involves two types of interface operations: categorization and refinement. Categorization is to decide whether a claim is a *finding* statement, or a *substantiate* statement or a *refute* statement. The categorization is performed by dragging and dropping claims from claim list to a category slot.

3.5 Phase IV: Communicate Statements

In this phase, the claims are compiled into a set of statements of manageable length. These statements must be presented in a way that is easily understood by local citizens. Special care is given to the use of language that state expert and professional knowledge in a form usable by the general public. The final Citizens' statements contain ten statements of *Findings* that summarize the issue and why it is important to the community. Another ten statements are allocated to the five strongest arguments in favor of the issue and five strongest arguments against the issue (Fig. 3).

3.6 Facilitative Moderation

CIR requires expert facilitators to be coupled with system support. Facilitators serve on a number of roles. Firstly, they mediate the conflicts among views on issue-relevant information, and manage different understandings, values, and knowledge [13]. Second, facilitators coordinate with the panelists and experts.

The facilitator practices its function through a control panel in the online system. From this control panel, the facilitator can monitor panelists' activities, control the process through a sequence of phases, manage schema, and manage documents.

3.7 Supporting Collaboration

In addition to entity-eccentric discussion and editing, collaboration among panelists is supported mainly through a chat room. Communications among panelists and subject matter experts are supported through a question panel. Panelists can directly ask a question in the question panel. Some of the questions can be answered immediately by peers. Others may have to be forwarded to subject matter experts. Once answers are received, they will be incorporated into the document collections.

4 Case Study

In order to test our implementation of CIR and iteratively improve it, we conducted a case study to gather the feedback from the potential panelists.

4.1 Procedure

The community issue used in this study is *inflationary tax indexing*. The proposal is that *real estate tax should be increased by at least inflation every year just to keep pace with the cost of providing services to the Borough*. We recruited fourteen participants as the citizen panel. Most of them were recruited via mailings that were sent at random based on the addresses provided the borough office. Three of them from specific student organizations were recruited via targeted email. The three students rent in the borough. The rest are homeowners. There are also four subject matter experts involved. Two of them are proponents that support the inflationary tax indexing, and two are opponents against the issue.



Fig. 3. Face-to-face meeting on Day 1

The study lasted ten days. On the first day, a short introduction and a training session were conducted in the face-to-face meeting. In the first session, the moderator introduced the community issue review in terms of its process, expected outcome and various roles. Then the community issue of *inflationary tax indexing* was introduced, followed by a *question and answer* period that allows the panelists to ask questions.

After the meeting, the panelists went home and began to work in the online environment. They were expected to follow CIR phases and collaboratively produce candidate statements for the final-day meeting to discuss. During this period, a facilitator kept monitoring the online activities and moderate the process when necessary. To ensure steady progress, the facilitator sent emails every morning, along with a summary of the progress by far. In the final day meeting, the panelists discussed and finalized the 20 citizen's statements.

We wanted to gather input from the participants as much as possible since this is still a preliminary study, thus an exploratory approach was employed to collect their feedback. During each of the work sessions, researchers conducted observations and asked the panelists to describe what they were doing and thinking aloud, especially the intentions behind behaviors. We only provided guidance and assistance whenever the participants had confusion.

4.2 Evaluation and Feedback

Based on the participants' feedback and our observations, we compiled a series of points and summarized them in this section.

Knowledge Crystallization Scheme. Without knowing how to decide and choose the knowledge schema, we adopted a set of themes as the knowledge crystallization scheme in this study. Each theme represents one important aspect of the issue and is shown as a phrase with detailed explanations on demand. For example, "Affordability" was used in the study as a theme, which indicates how a tax increase affects the price of owning and renting properties.

All the participants reported that the themes were only useful for the first phase to organize extracted nuggets. It was difficult for them to continue to use the themes as the extracted nuggets were transformed into claims. Instead, some of the participants suggested that several guiding questions would be more helpful for all phases.

Phase Transition. We organized CIR as an explicitly phase-based process following the IBKC framework (Fig. 2). Phases switch only when all participants feel that they have completed the current phase and ready to move on to the next phase. By enforcing phase-based process, panelists were expected to work synchronously and thus their contributions could be evaluated and utilized collaboratively.

However, Some participants reported that it was difficult for them to divide phase clearly; it caused confusion to them as they had to understand exactly the design of each phase. To address this problem, we enhanced our system by allowing panelists to be able to do all the work in one integrated interface where phases are implicitly enforced. We presented the revised interface to two participants and received positive feedback.

Learnability and Accessibility. The most common issue pointed by the participants was the usability of the online system. The participants were unaware of many available features and sometimes used the system in an incorrect way. The targeted users are ordinary citizens, among which many have insufficient computer skills. Therefore, on the one hand, the system should be designed to be easier to learn and operate. On the other hand, a more sophisticated technical support and training session should be provided.

Collaboration, Coordination, and Communication. Our observations show that participants communicated a lot in face-to-face meetings while they worked almost individually in the online environment, though a variety of communication channels were provided. One participant believed it is due to time delays in asynchronous communication while people do expect immediate responses or in-time notification. This was explained by [4].

One improvement is to provide subscription/notification service: Once a participant makes a contribution to an entity, she is considered to subscribe to the related thread. Whenever there is an update, e.g., another participant leaves a comment, the participant will be notified. The idea of the private and public workspace was also mentioned by some participants, which allows the participants to work in their private workspace and share with others only when necessary.

Flexibility of Organizing and Retrieving Contents. Currently all the entities involved in CIR, such as documents, extracted nuggets, assembled claims, and candidate statements, are structured in a linear fashion. Although some filters are provided that allow panelists to select, for example, the information nuggets tagged by a particular theme, it is still limiting the way of organizing them. Some participants would like to see the system provide more means of structuring the entities, for example, to cluster documents based on contents in advance.

Another feature the participants hope to have is a search function. We intentionally removed the search function as a way to enforce people to go through all the documents thoroughly rather than doing a keyword search when doing sense-making. However, the participants do have a need to revisit what they have read, and search function can support that. Bookmarking is also a solution to that.

5 Discussion and Conclusion

In this paper, we identified the challenges caused by information overload and knowledge deficit that prevent ordinary citizens from participating public life effectively. Drawing from observations of how local government decision-making works and theories of information, we proposed CIR, an instance of knowledge crystallization, as a solution to the above problem. We implemented CIR with the help online technologies and presented it to a group of citizens strategically selected. Based on lessons learned from their feedback, we developed a better understanding of CIR process and the need for improving this process.

Community Issue Review should be considered as a general framework that can be implemented in a variety of the contexts and processes. The current implementation of CIR (as described in this paper) is far from being perfect. On the technical side, many system-support features are to be further refined and optimized. We are incorporating the lessons learned from experimental observations and the feedback collected from the case study to enhance the support for

collaboration and communication among panelists. On the social side, our design of the CIR process should consider the vulnerability of the process and outcomes to *power influences*. In our observation of CIR practices in State College Borough, the Borough's council members are clearly the power holders since they make the final decision. The council can influence the CIR process by framing the policy issues from the government point of view, imposing pressure on which issue to be reviewed and limiting policy options to be considered. To balance such potentials of power influence, we have explicitly included a few mechanisms in CIR to empower citizens. *First*, the citizen panel of CIR is the only body to execute the creation of the citizens' statement, and other players (subject matter experts, municipal staff, researchers) are all playing a supporting role during the process. *Second*, we run a special session of "issue-framing" in Day-1 of CIR to allow the panel to generate its own way of framing the policy issue and propose alternative solutions. *Second*, we asked the panel to deliberate on their value propositions and challenge those from the experts and the government. For the above reasons, we argue that citizens' participation in the CIR redistributes more power from the council to the citizens, compared to the existing citizen consultation methods that do not garner much participation.

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References

1. Card, S.K., Mackinlay, J.D., Shneiderman, B.: Readings in Information Visualization: Using Vision to Think. Morgan Kaufmann, San Francisco (1999)
2. Chambers, S.: Deliberative democratic theory. *Ann. Rev. Polit. Sci.* **6**, 307–326 (2003)
3. Council, N.R.: Understanding Risk: Informing Decisions in a Democratic Society. National Academy Press, Washington, D.C. (1996)
4. Curtis, D.D., Lawson, M.J.: Exploring collaborative online learning. *J. Asynchr. Learn. Netw.* **5**(1), 21–34 (2001)
5. Elliman, T., Macintosh, A., Irani, Z.: A model building tool to support group deliberation (eDelib). *Int. J. Cases Electron. Comm.* **3**(3), 33–44 (2007)
6. Friess, D., Eilders, C.: A systematic review of online deliberation research. *Policy Internet* **7**(3), 319–339 (2015)
7. Gastil, J., Levine, P.: *The Deliberative Democracy Handbook: Strategies for Effective Civic Engagement in the 21st Century*. Jossey-Bass, San Francisco (2005)
8. Gastil, J., Richards, R.: Making direct democracy deliberative through random assemblies. *Politics Soc.* **41**(2), 253–281 (2013)
9. Gudowsky, N., Bechtold, U.: The role of information in public participation. *J. Publ. Deliber.* **9**(1) (2013)
10. Hagen, L., Harrison, T.M., Uzuner, Ö., Fake, T., Lamanna, D., Kotfla, C.: Introducing textual analysis tools for policy informatics: a case study of e-petitions. In: *Proceedings of the 16th Annual International Conference on Digital Government Research (dg.o 2015)*, pp. 10–19 (2015)

11. Kavanaugh, A., Ahuja, A., Pérez-Quiñones, M., Tedesco, J., Madondo, K.: Encouraging civic participation through local news aggregation. In: Proceedings of the 14th Annual International Conference on Digital Government Research, pp. 172–179 (2013)
12. Kropczynski, J.N., Cai, G., Carroll, J.M.: Understanding the roles of artifacts in democratic deliberation from the citizens initiative review. *J. Soc. Med. Organ.* **3**(2), 1–22 (2015)
13. Moore, C.W.: *The Mediation Process: Practical Strategies for Resolving Conflict*. Wiley, New York (2014)
14. North, C., Chang, R., Endert, A., Dou, W., May, R., Pike, B., Fink, G.: Analytic provenance: process+interaction+insight. In: CHI 2011 Extended Abstracts on Human Factors in Computing Systems (CHI EA 2011), NY, USA, pp. 33–36. ACM, New York (2011)
15. Panagiotopoulos, P., Gionis, G., Psarras, J., Askounis, D.: Supporting public decision making in policy deliberations: an ontological approach. *Oper. Res.* **11**(3), 281–298 (2011)
16. Price, V., Neijens, P.: Opinion quality in public opinion research. *Int. J. Publ. Opinion Res.* **9**(4), 336–360 (1997)
17. Resnikoff, H.L.: Concurrent computer and human information processing. In: Zunde, P., Agrawal, J.C. (eds.) *Empirical Foundations of Information and Software Science IV*, pp. 63–73. Springer, Boston (1987)
18. Richards, G., Belcher, K., Noble, B.: Informational barriers to effective policy-public communication: a case study of wind energy planning in Saskatchewan Canada. *Canad. Publ. Policy* **39**(3), 431–450 (2013)
19. Rowley, J.: The wisdom hierarchy: representations of the DIKW hierarchy. *J. Inf. Sci.* **33**(2), 163–180 (2007)
20. Yin, Z., Cao, L., Gu, Q., Han, J.: Latent community topic analysis: integration of community discovery with topic modeling. *ACM Trans. Intell. Syst. Technol. (TIST)* **3**(4), 1–21 (2012)