TOWARDS BETTER VOTING TECHNOLOGY RESEARCH: Building a Research-Industry Dialogue

A Report on the VOTING SYSTEMS VENDOR WORKSHOP

On March 13, 2007, the Caltech/MIT Voting Technology Project convened a Voting Systems Vendor Workshop on the Caltech campus involving a small group of academics and representatives from the voting systems industry. As an outcome of this one-day event, we present the following report and recommendations. This event was supported by grants from The Carnegie Corporation of New York and the John S. and James L. Knight Foundation. We thank them for their support of our ongoing efforts.

This unique one-day research strategy workshop brought together members of the academic community, members of the voting technology industry ("the vendors"), and a few representatives of other academic research efforts with the goal of improving voting technologies by identifying the most important questions in voting technology and developing collaborations between the vendors and the academic community. We undertook this effort because today the voting technology industry finds itself under unprecedented scrutiny and public criticism.

While the 2000 presidential election raised many questions about the state of voting technology in the United States, especially the spotlight shown on the election in Florida, repeated problems with election administration in elections since then have raised further concerns about the technology and the industry that produces and sells that technology. Whether these concerns have merit we leave for later analysis. At this point, we simply want to note that concerns exist and the industry is under a great deal of pressure from governmental agencies, their clients, the public, and many other groups in the United States.

Unlike many other areas of technological development, the voting technology industry is not one that has, to date, involved any significant academic-industry collaborations and partnerships. The VTP has always seen this lack of collaborative and interactive research between academia and industry as problematic. While our own work has at times been highly critical of the voting technology industry, we have always tried to maintain positive communication between members of our research project and representatives of the voting technology industry. We are also aware that our colleagues who are involved in other academic projects in this area also try to reach out to the voting technology industry, with mixed success. Finally, we know that the industry itself would appreciate better communication with the research community and that in some cases sees areas of potential research collaboration.

It is in this environment that the VTP issued invitations to representatives from the voting technology industry as well as representatives from other academic research efforts in the area

of election administration and voting technology to participate in this workshop. Our hope was that this unique, and unprecedented workshop, would stimulate productive, positive and collegial conversation about where voting technology research should proceed in the next few years. We also hope that the conversations that we might start at this workshop will lead to other discussion and perhaps active academic-industry research collaborations.

Our expectations for this workshop were exceeded. We were amazed at the willingness of academic and industry representatives to participate in this workshop and even more amazed at the depth, intensity, and collegiality of the conversation. The workshop was structured so that the academics spent the morning session presenting their perspectives on new research initiatives in the next few years. In the afternoon session vendors to provided feedback and offered their suggestions for academic research topics they view as in critical need of development in the near future. We concluded the day with a brainstorming session, a time when many productive ideas for where voting technology research should be directed were proposed.

For this workshop, we invited vendors and academics who are interested in working together to improve voting technology. While topics of approaches for software quality were discussed in some detail, the most urgent requests from vendors consisted of approaches to improving their ability to manage the quality of ballot design and chain of custody within each of their clients' jurisdictions. Several speakers discussed future approaches of technology for improving many aspects of voting technology, while at the same time the workshop maintained an overall goal of developing productive relationships between vendors and researchers. We believe that cooperation is the best way for research to lead to voting technology improvements. In this vein, we suggest that there should be more opportunities for academic and vendor research collaborations; academic researchers need access to contemporary voting technology for independent analysis of voting systems; and vendors and researchers should work together to identify critical research and policy questions. In addition, vendors and researchers should work together to investigate ballot layout and interface issues, investigate the complexity of voter and poll worker instructions, assess the end-to-end efficacy of voting systems (including voters and poll workers), and provide forums for R&D discussions.

Vendors stated openly that this was a new and very welcome forum that could break through current barriers between practitioners and researchers in solving problems and setting the research agenda. We provide the following research and vendor recommendations that we hope will channel the intensity and excitement into new research approaches in the next five years.

SUMMARY OF TOPICS

Briefly summarizes here are the discussions of each session, to give readers a flavor of the substance and tone of the workshop deliberations.

Morning Session: Academic Research Presentations

» **Voting Technology Research Methods**

The morning session began with a discussion of **Voting Technology Research Methods**. The main topics discussed were the parameters of future voting technology experiments, and how to bridge science, technology and politics in electronic voting. As was the theme throughout the entire workshop, greater cooperation between vendors and academics was encouraged, and it was emphasized that successful experiments cannot be conducted without that cooperation. Many topics were suggested for future study including the usability and accuracy of full face ballot designs, the reliability of verification systems such as

electronic voting machines that are equipped with paper printers, the effect of undervote warnings, and the complexity of voter and pollworker instructions.

» **Early Voting**
The second session of the morning involved **early voting and voting by mail trends**. There was a discussion about how early voting varies state by state, and how the overall early voting trends are moving upwards. It was suggested that early voting could be a way to test voting machines, and that early voting could be a method to help vendors and election administrators work together to test their technology. Another suggestion was that vendors include a data field for tracking information within their voting systems, so that it would be possible to research voter requests to change votes during the early voting process.

» **Accessibility/Usability**
The third session of the morning involved the importance of **accessibility and usability** in the voting process. On the topic of user interfaces, the Low Error Voting Interface (LEVI) was proposed. LEVI is a ballot design that allows comparison of ballot and verification user experiences. According to the VTP's research, LEVI has been shown in laboratory tests to reduce errors by fifty percent. Future project ideas were to collaborate with vendors and election officials to test LEVI in actual elections, and also to test audio verification which has been used alongside LEVI to significantly reduce candidate selection errors.

» **Security**
The **security** of voting machines was the main topic of the fourth morning session. Three specific ideas proposed were: developing an optical scan system with a feature that shows what the optical scan is reading along with an optical scan confirmation screen; developing a system where a voter can pre-load their choices into a voting machine; and using the internet to "pre-vote" to study how close we can get to internet voting. Also, cryptographic auditing was discussed as a way to openly audit voting systems. The particular cryptographic system proposed provides a receipt with a tracking number that the voter can use to confirm online that their vote was cast. The hope is to include cryptographic auditing in the voting process, but not to change the voter experience. Lastly, techniques were discussed that can be used to improve the security, reliability, and transparency of voting machines. The three ideas proposed were to minimize trusted software; create full interaction audit logs, such as a DRE that could record a video of everything that a voter saw and did; and to have locally networked voting machines, where machines are interchangeable and an administrative console cannot tell pollworkers what to do.

» **Auditing & Forensics**
Auditing and forensics were the final topics of the morning session. Auditing was described as a simple way to help identify things that need to be done better, not just things that go wrong. Collaborations with vendors were proposed to help find a way to reconstruct what has happened in an election, as well as research into what are acceptable error rates. It was also recommended that vendors help academics by "idiot-proofing" their reporting, by conducting more informative logging, and by using standardized reporting language for data.

Afternoon Session: Vendor Presentations

The vendors each identified their concerns and issues relating to current voting technology. They also provided their insight on what academics might do to be productive collaborators in improving voting technology. Topics that were discussed included the pros and cons of disclosed source code and open source development, reducing candidate selection errors through better ballot design, remote voting technology, and improving pollworker operations and competency. The afternoon session concluded with a brainstorming session that brought to light many potential areas of academic/vendor collaboration.

» **Open Source Development and Disclosed Source Code**

- Look in detail at the risks/benefits of disclosed source. Look at the spectrum of disclosure: full (unfettered access on website) to various levels of "controlled" access.
- Develop an agreement between vendors and academics on what is open source development.
- The voting system vendors possess the institutional knowledge to run safe and secure elections. Academics should build on the knowledge of the vendors to help develop better voting systems.

» **Ballot Design**

- Develop and test better ballot design for DRE screens.
- Test the Low Error Voting Interface (LEVI) ballot design on the vendors' machines in real elections.

» **Remote Voting Technology**

- Research technical voter verification solutions for voting by mail.
- Research ways to protect against any and all threats using remote voting.
- Study ways to take remote voting and reduce the possibility of fraud through coercion.

» **Pollworker Operations and Competency**

- Conduct research on what people believe is "private" in the context of voting at public polling stations.
- Evaluate and study human factors of poll workers.
- Academics and vendors should work together to improve poll worker education and training.
- Institute mandatory voter training by poll workers that's verifiable.
- Perform a process study on what happens behind the scenes at polling stations.
- Research better ways to quickly verify voters during the registration process.

» **Other Ideas for Future Research**

- Conduct research on the accessibility and usability of the voter verified paper audit trail.
- Conduct a cost/benefit analysis of accessibility.
- Conduct research on what inspires voter confidence.
- Look at the certification issues that vendors encounter. The #1 problem is the new standards of certification, there's a ten-fold increase in certification costs for vendors.
- Perform a cost/benefit analysis of a uniform vs. non-uniform voting system in the U.S.

SUMMARY OF RECOMMENDATIONS

One of the most difficult things that we encountered as we reconsidered the discussions of this unique workshop was trying to distill from all of these different presentations and conversations a clear set of recommendations for research and collaboration over the next five years. Every presenter gave a set of recommendations, and many other recommendations and proposals arose in workshop and informal discussions. Here we present some of the recommendations that we felt were most compelling; that we focus on these and not others provided by presenters indicates that in our opinion these are our highest priorities in the near term for voting technology research.

1. Research goal priorities:
   - Creating a better understanding of voting system usability and accessibility, and how new technology can improve voting systems on both dimensions.
   - Developing and implementing data exchange standards for voting technologies.
   - Researching the utility of "open source" software in the election administration world, what the term means, and how "open source" models might apply in the specific context of election administration.
   - Investing resources into the study of remote voting, and how new technologies may improve the process of remote voting, including all current or potential modes of remote voting (by-mail, by-fax, in-person early or kiosk voting, and voting online).

2. Venues, like the March 13 Workshop, must be convened regularly to provide a continued forum for discussion of research problems and ideas, for the presentation of research results, and for further development of trust and collaboration between academics and the industry.

3. The funding community, especially federal agencies that have the resources and mandate to facilitate academic-industry collaborations and technology development, must step forward to provide resources for further conversations, for basic technology research and development.

CONCLUSIONS

We were pleased that we could bring together representatives from academia and industry, and have such a detailed, substantive, and productive day of discussions and deliberations about the future of voting technology research. But, as our recommendations show, we see this workshop as simply the first step in the development of greater trust between researchers and vendors, and thereafter hopefully the deepening of research conversations and the possible development of research collaborations. The voting systems technology industry has not been one that has sought out research involvement from the academic community, unlike many other industries. We see that the lack of cooperation and collaboration may have stymied or slowed the development of new and improved voting technologies, and may have impeded successful implementations of existing voting technologies. Developing research collaborations will not be easy, as they will need to be structured so that the freedom of academic researchers to pursue publication and dissemination of their research is preserved, while also giving industry the ability to safeguard their technology and intellectual property. But models exist for collaborations between academia and industry, and we need to look to those models for guidance as to how we can proceed to better study current and future voting technologies. Given the importance of voting technologies to contemporary democracies--and the continued concerns about voting technologies that crop up after many prominent elections in the United States--we are optimistic that this situation can change, and we offer this report as what we hope will be a positive step in the direction of cooperation and collaboration.

APPENDIX

Presentation materials, photos and participant bios can be found at:
http://www.vote.caltech.edu/events/2007/VendorWkshp/vendor.htm