ABSTRACT

This study of the Tennessee 2003 International Building Code (IBC2003) hearings identifies potential barriers to seismic mitigation activities such as the application of performance and consequence based engineering. Seismic mitigation in Mid-America is of interest because earthquakes in this region are low-probability, high-consequence events; past research shows difficulties in implementing mitigation efforts for such events. Toulmin argument analysis of the hearing transcripts shows that those in favor of IBC2003 adoption used stronger arguments. Further, the majority of technical experts who spoke favored IBC2003 adoption. However, all elected officials who testified opposed or wished to delay the IBC2003 adoption decision, citing economic concerns. Tennessee state decision makers delayed the IBC2003 adoption decision, which is still pending. The results illustrate how core social leaders and competing economic concerns can dominate seismic mitigation policy, overriding the arguments of technical experts. They also illustrate the importance of considering a broader range of consequences in seismic mitigation decision analyses, and that technical experts need to work more closely with core social leaders to consider and implement mitigation actions.

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INTRODUCTION

Performance based engineering (PBE) and consequence based engineering (CBE) are two recently developed paradigms that can help build more earthquake resilient communities. PBE aims to accomplish this through its use of specified component performance objectives throughout project design. CBE aims to accomplish this by assessing consequences across the system of interest and designing targeted interventions accordingly. Application of these paradigms in the design of new buildings offers the hope of reducing loss of life, property damage, and business service interruption after natural disasters.

Despite their promise, new engineering paradigms for risk reduction often encounter resistance. May (2002) and Abrams et al (2002) note potential barriers to implementation of PBE and CBE, respectively. These barriers range from the need to refine these methodologies for use in seismic applications to the difficulties of incorporating these methodologies into current seismic engineering practice. Additional possible barriers include the inability of experts to explain the benefits of seismic investments adequately, the social and economic tradeoffs required to make such investments, and the resulting potential unwillingness or inability of stakeholders and decision makers to adopt, or sometimes even consider, seismic mitigation options. This study explores these potential barriers to seismic mitigation through an analysis of stakeholder arguments in the recent Nashville and Memphis hearings regarding adoption of the seismic provisions in the IBC2003 updated building codes. The results provide several lessons for those interested in implementing PBE and CBE.

Earthquakes can cause billions of dollars in damage and the deaths of thousands in the United States as evidenced by the $10 billion in damage caused by the 7.2 magnitude 1989 Loma Prieta earthquake (Berke and Beatley, 1992). The Midwest and specifically those communities in the New Madrid Seismic Zone (NMSZ) are particularly vulnerable to earthquakes. The largest recorded earthquake in the continental United States struck this region in 1811-1812. Estimates of the consequences of an earthquake of similar magnitude striking this region today include property losses up to $51 billion, 4,900 deaths, and 460,000 people left homeless (Berke and Beatley, 1992 from FEMA, 1989).

In spite of these potential losses, many communities in areas of high seismic risk within the United States, specifically those communities in the central and eastern United States, have not enacted significant earthquake preparedness policies such as the adoption of building codes with more stringent seismic requirements. Berke and Beatley (1993) note that “stronger building codes and construction standards are one of the most effective approaches for mitigating earthquake risk in new development.” However, many communities in this region either do not have building codes or have codes that do not reflect updated earthquake hazard maps published by the U. S. Geological Survey. For example, of the seven states in the New Madrid Seismic Zone, only three have enacted the 2000 version of the International Building Code (IBC2000) or later statewide (ICC, 2004; see Table 1). Furthermore, even those communities with building codes often have a significant number of structures built either before codes were enacted or under codes without current seismic standards. For example, many buildings in St. Louis (which currently uses the BOCA 1999 building code) were built prior to 1940; as of the early 1990s, eighty percent of them were unreinforced masonry, built on unstable soil (Farley, 1998).

Understanding the basis for this apparent discrepancy between the level of seismic risk and the adoption of mitigation measures is an important step in developing more effective seismic mitigation policy, especially for communities that have to this point resisted new mitigation
measures. This case study of the Tennessee 2003 International Building Code (IBC2003) adoption hearings is designed to contribute to that understanding.

The first section below describes previous research on potential barriers to adoption of seismic mitigation measures, including reasons why communities may not adopt recommendations from technical experts. The following section describes the data and methodology used in the study, including descriptions of the status of building codes throughout Mid-America and the seismic risk in the region; the background and purpose of the IBC2003 hearings in Tennessee; and the argument and media analyses performed to assess barriers to IBC2003 adoption in Tennessee. Findings and policy implications conclude, including suggestions for how engineers can better contribute to public seismic risk reduction decisions.

THEORY

Deciding whether to adopt building codes is not solely a matter of reducing seismic risk, but also a matter of other concerns held by stakeholders, such as increased construction costs and potential effects on economic development (Burby et al, 2000). It is well known that public sector decisions involve divergent interests with a wide set of difficult-to-establish criteria (Bots and Lootsma, 2000). As such, technical explanations of seismic risk are not, and cannot be, the only input in deciding whether to adopt a new building code with more stringent seismic requirements. Other potential factors affecting building code adoption include seismic risk perceived by the public; seismic risk perceived by community key actors; potential economic ramifications of enacting the building code; and the influence of those arguing for or against adopting the building code.

Much research on public decision making with regard to seismic mitigation policy focuses on the relation between earthquake risk mitigation policy actions and the risk perceived by the public. This research relates the level of action taken to mitigate seismic risk to the public salience of this risk. In one example Farley (1998) notes that individual preparedness increases as the preparedness of one’s neighbors increases. He found that those preparing the most for earthquakes in the face of predictions were those who saw or knew others who were preparing. He also found that measures to increase salience, such as public information, positively affected earthquake preparedness.

Further research shows that maintaining high levels of awareness is difficult due to the perceived adequacy of available solutions (i.e., that whatever measures currently in place for earthquake prediction and mitigation are adequate for maintaining public safety). For example, Turner, Nigg, and Paz (1986) documented a general consensus among study subjects that scientists could already or would soon be able to predict the occurrence of earthquakes with some accuracy, indicating that as a whole, the studied population was comfortable with the adequacy of seismic safety measures.

Likewise, regulatory actions that seem to ensure earthquake preparedness are not as effective as thought by decision makers. Berke and Beatley (1992) noted that at the time of their study, South Carolina law required that communities adopting building codes were mandated to adopt the Standard Building Code, which contained seismic provisions. This law, however, did not require communities to adopt a building code, leaving many communities without the seismic protection sought by the regulation. Further, May (1991) notes that one explanation for the lack of code adoption in many communities is public indifference towards low-probability, high-risk
events and the resultant lack of a public constituency pushing for action with regard to disaster preparedness. Other low-probability high-consequence events such as terrorism can be highly salient, however, and as evidenced by the U.S. Patriot Act, can produce dramatic policy shifts. In general, risk perception research suggests that people perceive catastrophic risks as less acceptable, all else equal (Lichtenstein et al., 1978; Slovic, 2001).

Key actor (elected and administrative officials) opinion has often been cited as critical in enacting policies to increase earthquake preparedness (Mushkatel and Nigg, 1987a; Berke and Beatley, 1992). However, in one study the adoption of building codes was supported by nearly eighty percent of key actors in zones of moderate seismic risk, but this support had not led these actors to push for code adoption (Mushkatel and Nigg, 1987a).

In the NMSZ, Mushkatel and Nigg (1987b) found that the public was more supportive of seismic building codes than key actors. This result is unexpected and runs counter to earlier research (Mushkatel and Nigg, 1987b, from Drabek et al., 1983) which indicated that key actors in Missouri found seismic issues salient but perceived public interest to be low. Mushkatel and Nigg claimed at the time they were writing that the incongruence between public and key actor opinion might be due to the fact that seismic mitigation policy formulation was in its early stages, indicating that as time passed, key actors would shift to hold the views of their constituents.

In addition to perceived seismic risk, building code adoption is subject to the perceived economic impacts of the code under consideration. The research described above shows the importance of risk perception and key actor opinion on earthquake mitigation policy. Likewise, this research shows that the public has low interest in earthquake mitigation strategies in regions of low earthquake occurrence, leaving little or no motivation for decision makers to adopt new seismic mitigation strategies such as building codes. This research, however, does not address the fact that economic development may override hazard concerns. Burby et al. (2000) indicate that economic development concerns are a major factor in how stringent communities are in enforcing building codes.

As mentioned above, a major influence in the decision to adopt building codes is the social influence of those arguing in favor of or against adopting the given building code. In addition to key community leaders, technical experts can play a role in deciding whether or not a community adopts a building code. While U.S. policy is often characterized as technocentric (Jasanoff, 1986), the influence of technical experts on policy decisions may be less than that of core social leaders (Silver et al., 2002). Experts from organizations considered more credible and less ideological are generally more influential (Rich, 2001), suggesting that experts may not be influential when their credibility is low, either because of their ideology or organizational affiliation. Other potential explanations for why technical experts may lack influence include that the technical evidence may be: (1) complicated to a level as to be incomprehensible to the decision maker; (2) outweighed by competing evidence, such as political or economic concerns; or (3) directly disputed by technical evidence presented by another subject matter expert.

Policy processes in the United States are by nature complex and interactive (Jasanoff, 1986). This makes it difficult to identify the specifics of stakeholders’ expertise, authority and arguments, and how they influence decisions. Public building code hearing transcripts provide a unique opportunity to assess these specifics and, to some extent, their relationship to the outcome of the hearings. Hearings can result in: (1) a decision whether or not to adopt some or all of a new building code; (2) a request for additional hearings; (3) political maneuvers (e.g., delaying tactics, public pronouncements regarding the building code or the hearing process – including
letters to newspapers, and other public statements); and (4) changes in perceived risk by decision makers or the public. Given the previously documented low salience of earthquakes and perceived adequacy of current mitigation measures in Mid-America, we expected competing concerns to outweigh seismic risk reduction in the Tennessee hearings, despite our expectation that technical experts would have stronger arguments than others. To the extent that the hearings can demonstrate relative strength of influence, we expected social leaders to have a greater influence than others in determining whether or not IBC2003 would be adopted. We also hypothesized that Tennesseans would be perceived as more credible than others, though this is not directly testable with the available data.

RESEARCH DATA AND METHODOLOGY

Most of Tennessee is located in the NMSZ, a prime example of a low-probability, high-risk seismic region. The NMSZ lies within the central Mississippi Valley, extending from northeast Arkansas, through southeast Missouri, western Tennessee, western Kentucky to southern Illinois (St. Louis University, 2004). This region is home to millions of people and contains the cities of St. Louis and Memphis, respectively the eighteenth and forty-second largest metropolitan areas in the United States (U.S. Census, 2000).

The NMSZ presents the greatest seismic hazard in Mid-America. Between one and two hundred earthquakes occur annually in the NMSZ, as compared to the two to three thousand that occur annually throughout the United States, many in California. The majority of these earthquakes are too small to be felt, but earthquakes large enough to be felt occur in the NMSZ approximately once per year (St. Louis University, 2004). The largest earthquakes to occur in the region since the devastating 1811-1812 earthquakes were a 6.0 and a 6.2 magnitude earthquake in the late 1800s.

In spite of the potential for seismic activity, a review of the states in the NMSZ indicates mixed progress in adopting building codes with seismic provisions. Though all states in the NMSZ have enacted some form of building code (USGS, 1995), only three have adopted the IBC2000 series codes, which contain updated seismic provisions (ICC, 2004). Table 1 displays the status of building code adoptions in the seven states with regions located in the NMSZ. Tennessee and Missouri (the states with the largest metropolitan areas in the NMSZ) have not adopted an IBC2000 series code statewide (ICC, 2004).

<table>
<thead>
<tr>
<th>State</th>
<th>IBC2000 and 2003 Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>statewide</td>
</tr>
<tr>
<td>Indiana</td>
<td>statewide</td>
</tr>
<tr>
<td>Illinois</td>
<td>39 communities</td>
</tr>
<tr>
<td>Kentucky</td>
<td>statewide</td>
</tr>
<tr>
<td>Mississippi</td>
<td>12 communities</td>
</tr>
<tr>
<td>Missouri</td>
<td>39 communities</td>
</tr>
<tr>
<td>Tennessee</td>
<td>3 communities</td>
</tr>
</tbody>
</table>
Tennessee is in the process of deciding whether or not to adopt IBC2003. Recent attempts at adopting a statewide building code in Missouri failed in state senate discussions (Missouri, 2004). Also, both states and communities within states update or modify state building codes. So though IBC2000 or IBC2003 has been adopted in some states, either the entire state or some communities within these states have in some cases adopted provisions limiting the seismic design requirements. For example, the state of Kentucky has deleted the IBC2000 seismic design maps from the state building code and replaced these maps with a table containing seismic design loads for each county (Kentucky Building Code Supplement, 2003). Note that in the context of this paper, a community is any sub-state level government that has enough political power to enact its own construction standards (i.e., an incorporated town or city).

Data

IBC2003 adoption hearings were held in Tennessee in the summer of 2003. These hearings occurred as a result of a proposed rule change to update the state building code to IBC2003 and the state fire code to the 2003 Uniform Fire Code (UFC2003). Per the Tennessee Code, Annotated Section 4-5-204, public hearings are required to solicit comments on proposed state rule changes. The Tennessee Department of Commerce and Insurance (DCI), Division of Fire Protection organized and presided over these hearings, which occurred in two locations: Nashville on July 16 and Memphis on August 27.

A board of individuals from the DCI presided over each hearing and initially planned to register a decision in late 2003 on whether or not to adopt IBC2003 and UFC2003. Christy Allen, the Chief Counsel for Regulatory Boards in the Fire Prevention and Administration Division, chaired the Nashville hearings. Other board members present at this meeting were Emmett Turner, the Assistant Commissioner of Fire Prevention; Randy Safer, the Director of Codes Enforcement; Al Hancock, the Assistant Director of Codes Enforcement; and Meredith Sullivan, the Commissioner’s Office Legislator Coordinator. Paula Flowers, the Commissioner of Commerce and Insurance and the Tennessee State Fire Marshal, chaired the Memphis hearings. Other board members present at this hearing were Emmett Turner, Randy Safer, Al Hancock, Christy Allen, and Scott Legere, staff counsel supporting fire prevention.

Per procedure, the proposed change of building code was filed with the offices of the Tennessee Secretary of State and public notice of the hearing, including text of the proposed rule changes, was published in the June 2003 edition of the Tennessee Administrative Register. Department officials also gave notice of the hearings to the Tennessee Society of Architects and Engineers, the American Society of Civil Engineers, and all certified building and fire inspectors in the state of Tennessee. Many presenters, especially elected officials, felt, however, that insufficient notice was provided before the Nashville hearing.

The Tennessee DCI held a second hearing in Memphis to address concerns about the short notice for the Nashville hearing and to allow for additional comment by those in the Memphis community who expressed concerns at the Nashville hearings about the IBC2003 seismic provisions. These provisions were the focal point of the Memphis hearing as evidenced by the fact that the board presiding over the hearing specifically asked the presenters to limit their comments to the IBC2003 seismic provisions.

The hearings were run in presentation style format. Each presenter had a time limit, five minutes in the Nashville hearings and fifteen minutes in the Memphis hearings, and the ability to submit written comments. Where clarification was necessary, board members queried the
presenters. In spite of the limited notice, thirty-six individuals testified in the Nashville hearings, and thirty in the Memphis hearings. The verbatim transcripts from those hearings are analyzed below, including all available written comment.¹

**Methodology**

This study analyzes the public hearing arguments for and against code adoption in the two hearings, in light of presenters’ expertise and community status. To identify possible external effects on the adoption decision, media reports on the proposed code were also investigated.

To determine the quantity of arguments for or against IBC2003 code adoption, the transcript of each hearing was reviewed, and the claim and reasons (i.e., why the presenter makes the claim) of each presenter were documented as one of the following: supports IBC2003 seismic provisions, opposes IBC2003 seismic provisions, wishes to delay IBC2003 adoption decision, or does not comment on IBC2003. Additionally, presenters are classified as favoring the IBC2003 seismic provisions if they claim to support IBC2003 without mentioning these provisions. Likewise, presenters are classified as opposed to IBC2003 if they claim to either support IBC2003 except for the seismic provisions.

Toulmin’s argument model (1958) provides the theoretical basis for coding and analyzing the hearings. This paper goes beyond previous applications of the model (Alison et al., 2003) by assigning quantitative scores to arguments and reasons. Coders assigned one point for every listed reason determined to be both relevant and effective. If no evidence was given to support a reason, no points were awarded for that reason. If evidence was given to support a reason, coders assigned an additional point to the argument for every piece of supporting evidence judged sufficient, credible, and accurate. Coders deducted one quarter of a point, up to a maximum of one point from the argument score for each qualifier to a claim. Also, one quarter of a point was added to each argument score for each added rebuttal.

As noted by Walton (1992), the persuasiveness of an argument is generally based on “cold logic.” The framing of an issue can also be persuasive, however. For these reasons, the coding scheme includes documentation of appeals to group sentiment. Walton argues that appeals to popular sentiment (ad populum) are common, a fallacy, and a framing technique that can be persuasive. Coders awarded one point for appeals that claimed the support of a large population subset (greater than one thousand individuals); two thirds of a point for the support of a mid-size population subset (greater than one hundred individuals); and one third of a point for the support of a small population subset (less than one hundred individuals).

To determine the social status of each presenter, the stated residence and backgrounds of each presenter were documented. Presenters were classified either as technical experts, elected officials, or (other) stakeholders. To further examine the effect of testimony from core social leaders, presenters were classified as either residents or non-residents of Tennessee. Technical expertise is of course contextually defined; however, as this research involves examination of seismic building codes, the following general rules were applied to determine who is classified as an expert:

- the individual must be a representative of an institution (academic, professional, or governmental) that is known to study earthquakes, or structural dynamics; or

¹ Written comments were obtained for the Memphis hearing, but written comments for the Nashville hearing were not obtained in time to be included in this paper.
• the individual must be trained or employed in the fields of seismology, geology, or structural, civil, environmental, and mechanical engineering; or
• the individual may be recognized by those at the hearing as a subject matter expert, as recommended by Shanteau (1992).

The presenters typically listed their professional and educational backgrounds as part of their hearing testimony or were introduced by other presenters, making classification as a technical expert or as an elected official relatively straightforward. For this analysis, all presenters not classified as technical experts or elected officials were classified simply as stakeholders.

Argument coding and personnel classification were performed independently by two coders. The coders, who had a mixture of public policy and engineering backgrounds, coded the hearings individually based on written instructions from the first author, then met to discuss general coding questions, refraining from discussion of specific statements. After this meeting, the coders individually made revisions to their analyses and again met to discuss general coding issues, this time discussing those specific arguments where they assigned significantly different scores. Each coder revised his/her coding again based on this second meeting. The results presented below are the average of the two coders’ final scores. After the second meeting, the coders scored arguments within two points of each other for all but three presenters. Inter-coder reliability was calculated using Cronbach’s alpha to be 0.799 after the first meeting and 0.972 after the second meeting. There was complete agreement between the coders for argument claim and social group classification.

Local and national media articles covering the code hearings or general earthquake risks were also reviewed in an attempt to capture those events external to the hearings (i.e., general public opinion, risk perception, and earthquake salience) that might affect the building code adoption decision. The Commercial Appeal of Memphis and the New York Times, the Washington Post, and USA Today were reviewed via a LexisNexis database search. This review consisted of a search for the number of references to “earthquake;” “Memphis” and “seismic;” “Shelby” (Memphis lies in Shelby County) and “seismic;” “Tennessee” and “seismic;” “Memphis” and “building code;” “Shelby” and “building code;” “Tennessee” and “building code;” “IBC;” “IBC2003;” and “building code” and “hearings.” The search was conducted for the time period of June 1, 2003, six weeks before the initial hearing, to May 31, 2004. To provide a baseline for comparison, the same searches were performed for The Commercial Appeal for the previous year.

**FINDINGS**

Tables 2 and 3 display the total number of presenters in each social group (experts, stakeholders, and elected officials) supporting the different claims at the Memphis and Nashville hearings, respectively.

As shown in these tables, the Memphis presenters were more vocal in their opposition to IBC2003 than was the statewide community that presented in Nashville. This discrepancy may be attributable, in part, to the fact that much of the support in the Nashville hearings was for IBC2003 in general rather than for the seismic provisions. In fact, many of the presenters in Nashville did not even mention the seismic provisions.
Table 2. Memphis Hearing Presenter Claims

<table>
<thead>
<tr>
<th></th>
<th>Tennessee Resident</th>
<th>Non-Resident</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experts</td>
<td>Stakeholders</td>
<td>Elected Officials</td>
</tr>
<tr>
<td>Support IBC2003</td>
<td>5</td>
<td>3</td>
<td>--</td>
</tr>
<tr>
<td>Oppose IBC2003</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Delay IBC2003</td>
<td>--</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>No Claim Stated</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Totals</td>
<td>8</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 3. Nashville Hearing Presenter Claims

<table>
<thead>
<tr>
<th></th>
<th>Tennessee Resident</th>
<th>Non-Resident</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experts</td>
<td>Stakeholders</td>
<td>Elected Officials</td>
</tr>
<tr>
<td>Support IBC2003</td>
<td>5</td>
<td>11</td>
<td>--</td>
</tr>
<tr>
<td>Oppose IBC2003</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Delay IBC2003</td>
<td>--</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>No Claim Stated</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Totals</td>
<td>6</td>
<td>17</td>
<td>2</td>
</tr>
</tbody>
</table>

Argument Rationale and Strengths

Argument analysis of the Nashville IBC2003 adoption hearings showed statewide support for IBC2003 adoption, though it was weak. Of the thirty-six presenters at the hearing, nineteen supported IBC2003 adoption, including the seismic requirements. Of the remaining seventeen presenters, ten opposed IBC2003 adoption (six outright and four asking for a delay to perform a cost benefit analysis); seven made no comment or did not address IBC2003 in their comments. Those supporting IBC2003 adoption deferred to experts and the necessity of stringent building codes in the face of seismic hazard, as reflected by the following statements: “we have come to the conclusion [that] the most effective way of preventing loss of life and loss of property is an adequate building code” (Mike Mahoney, FEMA); and “we feel that [the experts compiling IBC2003] represent the best set of experts that we have in the field and feel that the advice that is given…is consistent and represents the current knowledge base within this country” (Bob Paullus, Structural Engineers Association).

Those objecting to IBC2003 adoption preferred economic arguments, specifically the argument that enforcing IBC2003 would harm the economy and economic development in Tennessee. These presenters made statements such as the following: “[IBC2003 will] jeopardize our recruiting of […] industry” (Bill Revell, Mayor of Dyersburg); and “IBC 2003 would bring
the total cost of mitigation to about ten to twenty times the benefits” (Seth Stein, professor of geology at Northwestern University). Table 4 displays the primary reasons given for favoring or opposing IBC2003 adoption at the Nashville and Memphis hearings. Note that many presenters listed multiple reasons in their arguments, resulting in a greater number of reasons than presenters.

The Nashville hearings are further characterized by the fact that more experts favored rather than opposed IBC2003 adoption (see Table 3). Additionally, those opposed to code adoption generally had stronger arguments, though the result is not statistically significant. Table 5 displays the mean argument scores for the Nashville and Memphis hearings. In this table, the scores of those wishing to delay the code adoption decision and those directly opposing code adoption are combined.

In the Memphis hearings a larger number of presenters opposed than favored IBC2003 adoption, with seventeen presenters opposing and twelve presenters favoring IBC2003 adoption. Those presenters opposing IBC2003 adoption argued on grounds of economic development as reflected in the following statements: “Mayor Herenton and I are greatly concerned that as a state we are about to adopt codes that propose new standards that may seriously affect economic development and our tax base without adequate assessment of the costs and benefits […]” (Mayor Wharton, Shelby County); and “with the potential damage this code can cause to our tax base and economy […] is it appropriate for us to spend the extra public funds for the enhanced level of seismic protection above and beyond our current codes?” (Mayor Herenton, Memphis). Those favoring IBC2003 adoption argued on grounds of reducing seismic risk as follows: “these chances [of suffering a large earthquake in the NMSZ] are only about twice as good as playing Russian Roulette with a six-shooter once in the next fifty years […] these are relatively high chances that should make most people think twice about the real possibility of experiencing a devastating earthquake in the region” (Charles Langston, CERI) and “[…] there is no uncertainty that we live in a very active seismic zone […] the hazard is real and it cannot be compared to California” (Gary Patterson, CERI).

Table 4. Argument Reasons

<table>
<thead>
<tr>
<th>Reason</th>
<th>Claim</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nashville</td>
</tr>
<tr>
<td>The seismic hazard (does not) necessitates IBC2003</td>
<td>Favor IBC2003</td>
</tr>
<tr>
<td></td>
<td>Favor IBC2003</td>
</tr>
<tr>
<td></td>
<td>Favor IBC2003</td>
</tr>
<tr>
<td>IBC2003 reduces risk</td>
<td>6</td>
</tr>
<tr>
<td>IBC2003 has additional benefits</td>
<td>4</td>
</tr>
<tr>
<td>The experts agree the IBC2003 is the proper code</td>
<td>3</td>
</tr>
<tr>
<td>Other communities have (not) adopted IBC2003</td>
<td>3</td>
</tr>
<tr>
<td>None or indeterminate</td>
<td>6</td>
</tr>
<tr>
<td>Economic development will (not) suffer</td>
<td>3</td>
</tr>
<tr>
<td>IBC2003 implementation will belogistically difficult</td>
<td>1</td>
</tr>
<tr>
<td>IBC2003 is less important than other issues</td>
<td>2</td>
</tr>
<tr>
<td>IBC2003 should be judged in terms of life safety</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>22</td>
</tr>
</tbody>
</table>
Table 5. Argument Scoring in Nashville and Memphis Hearings

<table>
<thead>
<tr>
<th>Hearing</th>
<th>Mean Argument Score</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Memphis</td>
<td>2.87 (n=12)</td>
<td>1.66 (n=17)</td>
</tr>
<tr>
<td>Nashville</td>
<td>1.08 (n=19)</td>
<td>1.63 (n=10)</td>
</tr>
</tbody>
</table>

* The difference in the means between the “support” and “oppose” argument scores is significant at 5%.

More presenters with earthquake expertise favored rather than opposed IBC2003 adoption, and as shown in Table 5, those presenters favoring IBC2003 adoption had stronger arguments. Combining the two hearings shows a split on the opinion of whether or not to adopt IBC2003, with thirty-one presenters favoring adoption and twenty-seven opposed with neither those in favor nor opposed showing a statistically significant argument.

Presenter Credibility

As noted above, the credibility of presenters may affect which hearing testimony is more highly regarded. Research identifies core social leaders and technical experts as potentially influential. To compare their relative influence, the testimony of Tennessee state residents and elected officials is compared to the testimony from those not residing in Tennessee. Likewise, the testimony of technical experts is compared to non-experts.

The majority of the presenters were from Tennessee. In Nashville, twenty-five of the twenty-nine presenters discussing IBC2003 were from Tennessee. Three of the four presenters not residing in Tennessee were technical experts, with one expert opposing and the remaining experts favoring IBC2003. Of the twenty-five Tennessee residents, sixteen favored IBC2003 adoption, and nine did not. In Memphis, twenty-six of the thirty presenters were from Tennessee. The four presenters not from Tennessee all favored IBC2003 adoption; two of these presenters were technical experts. Of the twenty-six Tennessee residents, seventeen opposed and eight favored IBC2003 adoption.

With respect to technical expertise, the majority of the presenters were non-experts. Only nine of the thirty-six Nashville presenters had technical expertise. Of these nine presenters, seven favored IBC2003 adoption. In Memphis, ten of the thirty presenters had technical expertise, and seven of these favored IBC2003 adoption (one registered no claim, but only provided requested evidence).

Two elected officials presented in Nashville, and six presented in Memphis. All of these officials opposed IBC2003 adoption. Of particular note is that six of these eight presenters were mayors, though two of the mayors presented at both hearings. In Nashville, one official directly opposed IBC2003, while a second official asked for a delay in the code adoption decision so that a cost benefit analysis of the code could be performed. In Memphis, two officials directly opposed IBC2003, and four officials asked for a delay.

In spring 2004, the Tennessee Department of Commerce and Insurance decided to delay the IBC2003 adoption decision, nominally until late 2004. This action is consistent with the majority viewpoint expressed at the Memphis hearings, which was to oppose IBC2003 adoption or to delay adoption until further study could be completed to quantify the advantages and disadvantages of the proposed building code.
**Media Review**

Review of the news media yielded little press on the code hearings and seismic risk in Mid-America. The search terms described above produced 238 articles from national news sources and seventy-seven articles from local news sources between June 1, 2003 and May 31, 2004. In the national news sources, only six of the 238 articles discussed Tennessee building codes, earthquakes, or seismic hazard in Mid-America. One of these articles was an editorial opposing IBC2003 adoption, noting that “[…] back-of-the envelope estimates illustrate the new code's costs and benefits: over its approximately 50-year life, a building in Memphis loses about 1 percent of its value because of earthquakes, while the new code could increase a building's cost 5 percent to 10 percent” (Stein and Tomasello, 2004). The majority of the remaining articles were either unrelated or discussed earthquakes elsewhere in the world, with a focus on the Bam, Iran earthquake.

In the local media, thirty-four of the seventy-seven articles discussed earthquakes elsewhere in the United States or in the world; fourteen discussed earthquake resistant construction or seismic hazard in Mid-America; three discussed the IBC2003 hearings, reflecting arguments both for and against IBC2003 adoption. The remaining twenty-six articles discussed unrelated events. No editorials appeared in the news sources searched. Those articles mentioning the IBC2003 hearings noted that the hearings were occurring and summed up the opposing viewpoints as an economic development versus seismic risk reduction argument. For example, one article notes the following: “architects and developers also weighed in against the seismic standards, saying building costs could rise sharply if they're adopted” and “however, several researchers and engineers defended the seismic standards […]noting] recent studies indicating that New Madrid earthquakes of at least 7.4 in magnitude likely occur every 500 years instead of the 1,000-year interval accepted before” (Charlier, 2003). By comparison, the search of the previous year of local news articles in The Commercial Appeal yielded fifty-five articles with thirty of the articles discussing earthquakes elsewhere in the United States or in the world; ten articles discussing earthquake resistant construction or seismic hazard in Mid-America; three articles describing the costs and benefits of building codes; and eleven articles on unrelated events.

Despite the increase in the number of articles pertaining to earthquakes in the year surrounding the IBC2003 hearings, there is little indication that community awareness focused on the hearings. The majority of this increase is due to unrelated events, such as the word “earthquake” appearing in a sports article. The remaining increase is mostly due to an increase in coverage of earthquakes throughout the world, specifically the Bam earthquake. Likewise, though the total number of articles relating to seismic risk or building code hearings in Mid-America increased from thirteen in the previous year to seventeen in the year surrounding the hearings, this increase does not represent a significant percentage. Given that there were only fifty-five local articles relating to earthquakes in the previous year and seventy-seven local articles in the year surrounding the hearings, the percentage of the seismically-related articles that focused on Mid-America actually decreased from twenty-four percent in the previous year to twenty-two percent in the year surrounding the hearings.
POLICY RELEVANCE AND CONCLUSIONS

The Tennessee IBC2003 adoption hearings demonstrate that community leaders question the need for the IBC2000 series building codes and the adequacy of current building codes as compared to the IBC2000 series, in light of the potential costs of new codes. Although these are preliminary case study findings, they suggest that the testimony of core social leaders and competing economic concerns can, and do, outweigh the testimony of technical experts on seismic risk, even when – or perhaps because – the magnitude of the economic impacts is unknown. At the Memphis hearing those in favor of IBC2003 had generally stronger arguments, at least according to the Toulmin argument analysis. Also, more experts, including those residing in Tennessee, favored IBC2003 adoption generally, citing seismic risk as a reason for IBC2003 adoption. Based on the traditional view of the role of technical expertise in policy decisions, one would expect the adoption of IBC2003 from these results, but as noted above, the IBC2003 adoption decision was instead delayed.

There are several potential explanations for this decision, some of which are provided in the hearings. Decision makers may have found arguments presented by the experts and others favoring IBC2003 adoption too complicated. More likely is that these arguments were outweighed or disputed by competing concerns, or disagreed with those presented by local elected officials. The Toulmin argument analysis, however, indicates that neither of these explanations is likely. However, several caveats pertain to this analysis. Attributing causality in a single case study is a creative exercise. Further, the coding scheme used here is subject to a number of limitations that will be addressed in future analyses by including additional hearings, more coders, and tests of the robustness of the argument grading scheme. Finally, the media analysis for this study was performed solely by the authors and has yet to receive an independent review, including a verification of the search terms and sources used.

While events external to the hearings may have affected the decision, this is not evident from either the media analysis or the hearings transcripts. Other potential influences on the decision, such as correspondence between stakeholders and the IBC2003 adoption decision makers, were not documented and will be the subject of continuing research.

In the absence of external effects, the remaining explanation for the decision to delay the code adoption decision lies in either the fact that decision makers gave more weight to the economic concerns or found core social leaders more credible, confirming Silver et al’s (2002) observations. Tennessee residents were nearly evenly split on code adoption, with twenty-four residents favoring adoption and twenty-six opposed to or wish to delay adoption, but all elected officials opposed or wish to delay IBC2003 adoption. These results are similar to Silver et al’s, but suggest that Mushkatel and Nigg (1987b) predicted incorrectly that key actor opinion would shift over time to mirror that of their constituents.

The results also indicate a strong need for technical experts to work closely with community leaders to analyze and enact seismic mitigation policies. If seismic mitigation activities are to succeed, community leaders will have to support them. The hearings demonstrate that decision makers want engineers and other technical experts to analyze a broader range of consequences, including how costs and benefits vary with different mitigation options, in addition to the structural performance of specific buildings. If both PBE and CBE are viewed as engineering innovations, they may face challenges similar to those evident for the adoption of IBC2003 in Tennessee. However, because it addresses a broader range of consequences, CBE if fully
realized may in fact reduce barriers for improved seismic building code provisions, PBE, and other seismic risk reduction strategies.

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