Natural hazards mitigation in Tulsa:

the role of strategic policy innovation and social learning

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Introduction

In an ideal world, communities would learn from their experience with natural hazards and undertake actions to mitigate the risks associated with repeat events. Unfortunately, the real world is fraught with recurrent disasters, often afflicting the same communities in an insidious and destructive manner. Indeed, such was the case for Tulsa, Oklahoma (USA), a city that was subject to episodic and continuing flash-flooding hazards through the mid 1980s.

Fortunately, the city undertook a series of concerted actions to mitigate its vulnerability to flooding, and has now attained international renown for its achievements in natural hazard mitigation. Tulsa's transformation from hazard victim to hazard manager is a fairly well-known story (e.g. Patton 1993; 1994), but the specific role of the individuals who helped to design and implement the city's disaster-reduction strategy is less appreciated. Knowledge about entrepreneurial individuals who champion new public policies, or policy entrepreneurs, is important if society is to design effective approaches to mitigating natural hazards and building a more sustainable future (FEMA 2000).

In this article, we frame the issue of Tulsa's struggle with natural hazards in the context of public policy innovation, and focus attention on the role of the policy entrepreneurs whose inspiration and dedication to policy change and learning helped the city to mitigate its hazards in a more effective and enduring manner. Our focus on policy entrepreneurs mirrors growing interest in how policy innovations, particularly those innovations that advance prospects for sustainabilty, can be better understood and applied in various social contexts.

To this end we review current interest in policy innovation and illustrate the process in a brief review of Tulsa's flooding problems in its Mingo Creek watershed that illustrates what actions were taken to mitigate them. Next, we describe a recent study that identifies the strategies Tulsa's policy entrepreneurs adopted to overcome a variety of barriers to innovation, and discuss the implications of the findings for natural hazards policy and prospects for sustainability.

Policy innovation and learning

How innovation in public policy, or policy innovation, occurs has been the subject of a growing amount of scholarly interest in recent years for several reasons (Mazmanian and Kraft 1999; Stephan and Scheberle 2000). First, the federal government has been actively promoting the devolution of many of its programmatic responsibilities to the states and municipalities without concomitant resources. Moreover, municipal governments in the U.S. have been increasingly subjected to a variety of unfunded federal mandates, many of them environmental quality requirements, which obligate them to do more with less. In addition, federal funding for public programs has been precarious in recent years while urban problems have continued to mount. The growing trend toward the privatisation of public sector functions, which has ushered in the need to foster workable public-private partnerships, has also placed a premium on an improved understanding of the policy innovation process. Finally, understanding policy innovation is central to the national commitment to develop a more sustainable society.

Kingdon (1984) and Polsby (1984) were among the first researchers to examine the general patterns of policy innovation in government. Kingdon's well-known argument that the conditions for innovation are optimal when the politics, problem, and policy streams converge at a *window of opportunity* has been applied by several researchers in a variety of policy contexts (e.g. Birkland 1997; Rabe 1986). While the notion of a window of opportunity has penetrated both the policy analytic community as well as the general public's vocabulary, Kingdon's characterisation of the policy entrepreneur as a participant who motivates policy change had not received much attention by analysts until recently. Polsby's characterisation of policy innovations as either *acute* or *incubated* shed light on the distinctive difference between innovations that evolve relatively rapidly over time with limited information and few decision makers, such as the US reaction to the launch of the first Soviet satellite, Sputnik, compared to those that require a good deal more time to accommodate multiple decision makers, conduct technical studies, and become more widely accepted, such as the movement toward economic rationality (i.e. deregulation) that has become a growing trend in federal government programs.

More recently, Behn (1988) characterised his view of policy innovation as *groping along* since it best describes the trial-and-error approach that many agency managers experience in the uncharted and chaotic course of finding workable solutions to their problems. Behn suggests that managers have a clear sense of their agency's mission, but lack the time, resources, and stable environment necessary to develop comprehensive workable solutions. Rather, they grope along toward a solution, building experience, information, and momentum to attain their ultimate success one small step at a time.

In contrast, Golden (1990) found that a *policy planning* approach better addressed the experiences she examined in several human service organisations. The policy planning model differs from groping along due to the former's need for existing legislation that structures the innovation process, the existence of a clear idea and a method of implementation, a greater emphasis on time allocated to planning, and the limited amount of change expected from the innovation. Another valuable contribution is Sabatier and Jenkin-Smith's (1993) development of an advocacy coalition framework (ACF) that defines the conditions under which policy change and learning are most likely to advance. The ACF model captures the value

orientation of advocacy coalitions and describes the role that scientific and technical analysis play in policy deliberation and debate, but it tends to minimise the role of individual policy entrepreneurs in the policy innovation process.

The role of the policy entrepreneur has been addressed by several researchers, who suggest that the ultimate success of an innovation can be traced to the strategic actions that one or more entrepreneurs motivate in the course of an innovation. Deyle et al. (1994) studied the evolution of state coastal erosion policy and found that entrepreneurs were essential to the success of policy innovations in coastal management for several reasons. In the coastal setting, effective entrepreneurs understood the context of environmental issues and their policy relevance quite well. They also understood the importance of technical expertise and research that provided a sound scientific basis for assessing promising alternatives. While they acted in response to Kingdon's window of opportunity, they were also quite skillful in helping to open a window when needed. In their study of school vouchers, Roberts and King (1996) found that policy entrepreneurs were frequently drawn from a variety of occupations, interests, and backgrounds.

To advance understanding of the innovation process, Roberts and King (1996) developed a typology of entrepreneurs and applied it to their voucher study. They found that a policy entrepreneur could participate in an innovation at one or more levels of involvement, but that the degree of participation and the professional career status of the entrepreneur could be used to further define the role being performed. For example, policy intellectuals typically help to foster new ideas or alternatives. Policy advocates can help to advance new ideas but also develop them, sometimes through a prototype demonstration. Policy entrepreneurs (as Roberts and King define the term) motivate new ideas, demonstrate them, and implement them. Policy champions do the latter two steps. Policy administrators simply implement the innovation. Further specification can be assigned if the entrepreneur is employed in government (policy entrepreneur), holds a leadership position (executive or bureaucratic entrepreneur), or is publicly elected to office (political entrepreneur).

A recent review of leading policy innovations in the U.S. was reported on by Altshuler and Behn (1997) who used the Ford Foundation's annual competition in *Innovation in American Government* at Harvard's Kennedy School of Government as their database. Among other findings, the authors identified a dozen impediments to innovation that delay or prevent entrepreneurs from attaining successful implementation (see *Table 1*).

These impediments are categorised as:
- accountability dilemmas (who is responsible for innovating?)
- paradigm dilemmas (how can we be innovative thinkers?)
- analytical dilemmas (how much analysis should be done?)
- structural dilemmas (how do organisations stimulate innovation?)
- replication dilemmas (how do we transfer an innovation?)
- motivation dilemmas (who will innovate?).

Using the same database, Borins (1998) analysed the key success factors for all of the finalists in the Kennedy School database. Specifically concerning environmental innovations, he drew the following conclusions.

First, environmental programs are holistic; they increasingly involve systemic thinking about the management of entire ecosystems.

Second, environmental activists can be a valuable resource and support to policy entrepreneurs.

Third, policy entrepreneurs should rely on market mechanisms and user fees to support and enforce environmental programs.

Fourth, environmental innovations tend to involve politicians and public servants in different ways, with substantial movement across bureaucratic and political arenas.

Fifth, planning and policy analysis play an important role in the success of environmental innovations.

This list is instructive for the Tulsa case, since it suggests that environmental innovations necessitate more scientific and technical analysis than other kinds of policy innovations. It also implies that success flows from the ability of entrepreneurs to cross-organisational boundaries and to facilitate the interaction of political and nonpolitical actors.

In sum, the literature provides several insights into the conditions for successful policy innovations. Clearly, a variety of policy entrepreneur types must find ways to overcome impediments that are contextual and dynamic. In the case of environmental policy innovations, research indicates that a systems view blended with a variety of perspectives can foster useful alliances with advocates as well as strategies for program design, demonstration, and implementation. Knowledgeable policy entrepreneurs thus often behave in a strategic manner in the way they address these challenges. It is this blend of strategic actions that are observable in the innovation process that is referred to as strategic policy innovation.

Mitigating flash-flooding hazards along Mingo creek

Tulsa's history of flash-flood hazard

Accountability dilemmas—who is responsible for innovating?

Authorisation dilemma—be creative but hold yourself accountable.
Failure dilemma—who accounts for failure?
Customer dilemma—do you work for agencies or elected officials?

Paradigm dilemmas—what is the nature of the 'box' that motivates new ideas?

Routinisation dilemma—mind the rules.
Scale dilemma—how big should innovations be?

Analytical dilemma—how much analysis should be done?

Structural dilemmas—how innovative is the organisation?

Organisational-diversity dilemma—complexity of the task structure and incentive system determines the degree of innovativeness.
Federalism dilemma—institutional fragmentation impedes widespread adoption.

Replication dilemmas

Adaptation dilemma—what should be copied?
Organisational-adaptation dilemma—how can organisations adapt?
Dissemination dilemma—what are the hidden problems in an innovation?
Definitional dilemma—what aspects of an innovation can be replicated?

Motivation dilemmas

Media dilemmas—mean-spirited journalists can punish failure.
Reward dilemmas—what kinds of rewards will motivate innovations?
Elected-official dilemma—fear that failure can mean loss of job.

Table 1: Impediments to Innovation (after Altshuler and Behn 1997).

mitigation closely tracks and intersects with the national flood control experience at many different points in time. Accordingly, it has been convenient for authors to frame the city's trials and successes with its flooding problem within the specific eras of flood-hazard management that characterise the US effort in general. Flanagan (Flanagan and Associates 1994) and Patton (1993) refer to these eras as: the Structural Era of Flood Control (1928–1966); the Regulatory Era of Floodplain Management (1968–1978); and the Non-structural Era of Floodplain Management (1979–present). As it is for many federal, state, and local government policy innovations, the national context for flood control planning and management is important to understand the opportunities and constraints that confronted local policy entrepreneurs.

Expansion into the Mingo Creek drainage area began during the post-World War II suburban expansion in Tulsa. A second population boom occurred in Tulsa in the 1960s, leading to increased urbanisation of the city's floodplains. Despite repeated flooding of these floodplain areas in the late 1950s, development continued nonetheless. Arkansas River flood control was addressed upstream of Tulsa with the completion of the Keystone Dam by the U.S. Army Corps of Engineers (USACE) in 1964. The Mingo Creek drainage area was annexed into the city limits in 1966. During the 1960s, the Mingo Creek watershed experienced one flood event every two to four years. Increasing urbanisation of the watershed caused each flood to be worse than its predecessor due to greater volumes of runoff.

At the national level, concern about the limitations of structural flood control techniques led to legislation (1960 Flood Control Act) and an Executive Order on Floodplain Management (EO 11296) that encouraged floodplain planning, technical assistance, and mapping.

In 1968, the passage of the National Flood Insurance Act ushered in a new era of floodplain management. That year in Tulsa, the noted landscape architect Ian McHarg pointed out to the city's leadership that it was locating its parks on high ground and its homes in the floodplains. McHarg suggested that the city adopt an approach that echoed its own 1924 plan by creating a network of linear parks that would serve the dual function of abating flood hazards and providing for a community trail system. This advice was not heeded.

The City of Tulsa experienced a series of severe floods along Mingo Creek in the 1970s. The first of these floods occurred on Mother's Day, 1970. Flooding along Mingo and Joe Creeks caused $163,000 in damages. Tulsa joined the emergency program of the National Flood Insurance Program (NFIP) later this same year. The following year, Tulsa joined the regular NFIP program. Tulsa promised, as a condition of joining these programs, to adopt a new standard based on a 100-year flood and new land-use regulations. The next major flood occurred four years later. Flooding in April and May 1974 resulted in damages totaling $744,000.

The City of Tulsa and the USACE realised that a comprehensive, regional, long-term strategy was required. The goal of the strategy was to prevent flood events through a combination of structural and non-structural measures.

A storm on June 8 that year resulted in flooding along Mingo, Joe, Fry, and Haikey Creeks and $18 million in damages. Mingo flooded for a third time in 1974 on September 19.

The devastation wrought by this series of events catalysed citizen action. Carol Williams, a Mingo Creek flood victim, formed a lobbying group with other flooded residents named Tulsans for a Better Community. Despite their growing numbers, the lobby met stubborn resistance from the city's leadership. The city had no flood management plan and little interest in developing one.

After the September flood, Bob Miller, a flooded homeowner and Tulsans for a Better Community member, travelled to Rapid City, South Dakota to study that city's floodplain acquisition program. Upon his return, he presented a slide show to the mayor that illustrated the feasibility of relocating homes (Patton 1993). By 1975, the city had designed and begun the Mingo Creek Improvement Project, a limited channel project that included a

right-of-way clearance of 33 houses designed to protect 700 homes from floods comparable to those experienced the previous year.

The Memorial Day flood of 1976 was the most severe flood to that date. Ten inches of rain fell in three hours causing floods along Mingo, Joe, and Haikey Creeks. This flood led to three deaths and $40 million in damages. More than 3,000 buildings were damaged. Once again, Carol Williams pressed the city to take action, including a more aggressive floodplain acquisition program.

With the help of U.S. Congressman Jim Jones, funds for acquisition were secured through monies from Section 1362 of the flood insurance law. This approach later became national policy. Tulsans for a Better Community merged with the citywide Homeowners Coalition that was a more powerful advocate for change. After this flood, the USACE began working with the City of Tulsa to find a solution to the flooding problem that included 10 miles of channels and 23 upstream detention basins. In sum, the City of Tulsa implemented several innovations:
- a moratorium on building in the floodplain was enacted
- the first full-time hydrologist, Charles Hardt, was hired — Stan Williams was directed to draft city policies with regard to floodplains and development.
- the city was allowed credit or reimbursement by the federal government for Mingo Creek construction work undertaken since 1974.

The following year, 1977, saw the implementation of a series of flood control innovations:
- comprehensive floodplain management policies, regulations, and drainage criteria were developed
- stormwater detention regulations were enacted for new development
- an early alert and warning system was initiated
- master drainage planning for all major creeks was begun
- an earth change ordinance was enacted in 1978, giving the city control over alterations made to Tulsa's landscape.

The next major flood did not occur until eight years later. The Memorial Day flood in 1984 was the most devastating flood in Tulsa history. Fifteen inches of rain fell during the night. The flood accounted for 14 deaths, 288 injured, 7,000 buildings damaged or destroyed, and $184 million in damages. Damages along Mingo Creek accounted for 69 percent of the total monetary damage.

In the hours following the flood, newly

elected Mayor Terry Young organised a team comprised of himself, City Commissioner J. D. Metcalfe, Ron Flanagan, Charles Hardt, Ann Patton, and Stan Williams to assume the leadership of the city's largest and most innovative floodplain clearance and mitigation program. A paradigm shift in the city's understanding of how best to reduce flood hazards was now clearly underway.

The work of this initial Flood Hazard Mitigation Team led to the following results:

- three hundred flooded homes and a 228 pad mobile-home park were relocated
- a joint City of Tulsa and USACE detainment basin project was begun
- the Department of Stormwater Management was created in 1985 centralising responsibility for stormwater programs
- a maintenance program that cleared silt and debris from major creeks and tributaries was started in 1985
- a stormwater utility fee was established in 1986.

The City of Tulsa and the USACE realised that a comprehensive, regional, long-term strategy was required. The goal of the strategy was to prevent flood events through a combination of structural and non-structural measures. Partnerships with local, state, and federal agencies were part of the regional flood control strategy enacted by the City of Tulsa. The Mingo Creek Local Flood Control Project was completed in 1999. These policy innovations transformed Tulsa from one of the most frequently flooded cities in the nation into one of the least.

Policy entrepreneurs

The story of Tulsa's struggle with flooding documents the presence of a large number of policy entrepreneurs, each of whom made an important contribution to the ultimate success of the Mingo Creek project. The nascent strategy that the entrepreneurs developed was designed to draw several policy themes together in order to produce a more coherent and compelling flood control program. Over the course of time, the entrepreneurs learned much from the city's painful experiences with flooding and began to deploy more ambitious strategies that necessitated the development of an effective partnership with the USACE, access to more federal resources, increased flexibility in existing city ordinances and enactment of new ones that would address the system-wide aspects of the problem, and greater organisational capabilities and technical expertise to deal with the flood hazard in an effective and

responsible manner. To illustrate more clearly how the different elements of this strategic approach worked together, Roberts and King's (1996) typology of policy entrepreneurs can be used to identify the types of policy entrepreneurs who were engaged in finding innovative policies to resolve Tulsa's flood hazard dilemma.

Two individuals who played a pivotal role as policy intellectuals for Tulsa were Ian McHarg and Gilbert White. McHarg, whose nontraditional views on the relationship between the natural environment and the design of built systems are known worldwide, was invited to Tulsa to educate the city's leadership about alternative ways to reduce flashflood hazards. Gilbert White, who has been the leading intellectual in the national movement toward non-structural solutions to flooding hazards for several decades, provided the necessary encouragement and information that helped to guide the policy entrepreneurs' overall strategy. Attendance by Tulsa policy entrepreneurs at the annual Workshop on Hazards Research and Applications organised by White in Boulder, CO, also proved quite beneficial.

Since the context in which the policy entrepreneurs operated was fairly fluid, it is not unreasonable that many policy entrepreneurs would change their jobs and even their careers in the period under discussion. Therefore, the classification of the entrepreneurs is divided into two periods associated with the most significant flood events: the 1976 and 1984 floods.

Post-1976 flood policy innovations

Several people qualify as political entrepreneurs due to their actions in this period. The first of these is U.S. Congressman James Jones. Jones was one of the key people working for Tulsa on a national front by ensuring the passage of the Water Resources Development Act. This had the far-reaching impact of allowing actions that Tulsa had previously undertaken locally towards flood prevention to count towards its share of federal flood control projects. This act would become very important in 1984 when the USACE received authorisation to work on Mingo Creek. Other political entrepreneurs included Norma Eagleton, Patty Eaton, and Robert Frandon, who built upon the work of former commissioners Bill Morris and Sid Patterson. Eaton and Frandon, who were elected in 1976, influenced several innovations including: declaring a moratorium on building in the floodplain;

establishing stormwater detention regulations for new development; establishing new floodplain policies and drainage criteria; and hiring Stan Williams and the first city hydrologist, Charles Hardt (Patton 1994). They also encouraged the implementation of a rudimentary alert and warning system.

Three people qualify as bureaucratic entrepreneurs because they held formal, but not leadership, positions with the state or the federal government. Dell Greer became involved in the 1970s as a representative of the Federal Insurance Administration (which later became part of FEMA). He worked with Tulsa residents who were committed to solving the flooding problem. Greer worked with Tulsans, including Ann Patton and Carol Williams, to address the cause of the floods, which in some cases meant removing houses from the floodplain (Greer 1999). He became involved in 1974 and remained involved until the mid 1980s. Stan Williams and Charles Hardt were hired shortly after the flood. For the next few years, they were heavily involved in working on flood issues. Stan Williams worked on ordinances regarding the floodplains and development with Hardt (Hardt 1998).

Several people can be classified as policy entrepreneurs due to their involvement with the flooding issues and the fact that none held a position in government at the time. Ron Flanagan, a former city employee and planning consultant, offered his services to the flooded residents. Before 1974, Flanagan worked on zoning and planning issues with developers (Flanagan 1998). Beginning in 1974, Flanagan became intimately involved in the flooding problem along Mingo Creek. Flanagan, who helped educate the flooded residents about floodplains, was one of the people calling for a new method of flood control in the Mingo Creek watershed. Ann Patton was an activist, who as a newspaper reporter, covered flood stories and addressed the causes of the floods and the possible alternative solutions that could be employed to mitigate them. The articles she wrote encouraged new ways of approaching the flooding problem and placed pressure on the city government to act. Carol Williams was also involved with the citizens' movement demanding that something be done. Williams' house had been flooded three times in the mid-1970s, which motivated her to become very active in citizen groups, including Tulsans for a Better Community. She played an important role in organising these groups and in educating them about flood issues. Finally, J. D. Metcalfe, president

of Standard Industries, was responsible for helping organise the Floodplain Symposium in 1976 and inviting Ian McHarg to lecture at this presentation. Metcalfe took an active role in the flooding issues.

Post-1984 flood policy innovations
Several of the people identified as entrepreneurs in the post-1976 flood innovations also qualified as entrepreneurs in the post-1984 flood innovations. Their classifications, however, have been changed due to the different roles they played in 1984 and afterward.

Terry Young and J. D. Metcalfe were both political entrepreneurs. Young and Metcalfe were newly elected as Mayor and Street Commissioner, respectively. They assumed office only 19 days before the 1984 Memorial Day flood and were responsible for several of the more significant innovations that were implemented during that time. Mayor Young called Metcalfe the night of the flood and assembled the first Flood Hazard Mitigation Team, which was responsible for developing the mitigation measures put in place following the flood. Mayor Young decided to move those houses that had flooded repeatedly out of the floodplain. He also played a critical role in getting approval to use federal flood insurance money, combined with City of Tulsa monies, in the home buyouts.

In the aftermath of the flood, Young and Metcalfe continued their flood-prevention activities. Together, they were able to sell the public on the joint City of Tulsa-USACE plan for detainment basins. Young and Metcalfe were responsible for the creation of the Department of Stormwater Management. In 1985, they started a maintenance program that would clear debris out of major creeks. They also created the Stormwater Drainage Advisory Board (SDAB), a citizens' advisory board.

Four people qualify as executive entrepreneurs: Stan Williams, Neal McNeill, Charles Hardt and Michael Buchert because they occupied agency leadership positions. Stan Williams was hired as an assistant city attorney as part of the Flood Hazard Mitigation Team in 1984. He worked with City Attorney Neal McNeill on figuring out ways for Tulsa to legally accomplish the goals that Mayor Young had set forward. Williams worked closely with Hardt and Flanagan on the detention projects as well as securing funds for homeowner buyouts.

McNeill's biggest contribution was the legal support for a $2 per month stormwater utility fee, which was implemented in 1986 and assessed on every house and business in Tulsa. McNeill arranged the billing method so that the fee was taken out first; people were forced to pay the stormwater fee or else their water supply would be curtailed (McNeill 1999). Charles Hardt, who had been working in Denver, was hired by the City of Tulsa as a consultant after the 1984 flood as part of the Flood Hazard Mitigation Team (Hardt 1998). He brought the engineering experience he gained in Denver to bear on the Mingo Creek problem to provide a measure of legitimacy to the various projects. Michael Buchert started working for the Tulsa District USACE office in 1977 on possible flood control measures for Mingo Creek, specifically detention basins (Buchert 1998). This work played a large role in the USACE's offer to conduct a joint project with the City of Tulsa.

Two people qualified as bureaucratic entrepreneurs, having formal, but not leadership, positions with the government: Ann Patton and Carol Williams. Patton played a number of roles in the Mingo Creek saga. In 1984, she became an assistant to Street Commissioner Metcalfe and served as a motivating force for other entrepreneurs. Patton's most important role was with the media. It was because of Ann's writings and contacts with the media that much of the public became educated about proposed changes (Flanagan 1998). Patton subsequently took a formal administrative position with the Department of Public Works. Carol Williams also became employed by the City of Tulsa, where she worked on natural hazard mitigation and neighborhood development activities for the remainder of her career.

Ron Flanagan, a policy entrepreneur, began working with flood victims in the early 1970s. He left Tulsa in 1978 to work in Denver for a water engineering firm. Returning to Tulsa in 1984, he worked on the Mingo Creek project and was a member of the Flood Hazard Mitigation Team. His plans and designs played critical roles in the Mingo Creek project. Many people were involved with the project who did not qualify as entrepreneurs. This should not suggest that their actions and accomplishments were not important, it is just that they were not involved with as many aspects of the project.

Policy entrepreneur survey
In order to identify a more general pattern in policy entrepreneurs' behavior over time, additional case study research was conducted in related Tulsa policy innovations that occurred after the flooding events of Mingo Creek transpired. Two important environmental innovations include the development of the Metropolitan Environmental Trust (MET), beginning in the 1970s, which is responsible for promoting municipal solid waste recycling, and the development of the Ozone Alert! program, beginning in the 1980s, which utilises short-term behavioral changes among the city's constituencies to reduce emissions of tropospheric ozone precursor gases. For each of these two cases, as well as for the Mingo Creek case, as many of the key policy entrepreneurs were identified as possible, interviewed, and sent a survey questionnaire to fill out and return (Ziebro 2000).

Several variables have been identified in the literature as important in the innovation and associated social learning processes. The policy entrepreneur survey was developed to capture the degree to which variables identified in the literature as key to the innovation and social learning processes, were evidenced in the three separate cases. The questionnaire consisted of 15 closed-ended questions in which participants rated the importance of different variables. The first four questions focused on specific innovations. In these questions, the respondent was asked to choose just one of the three policy innovation cases under study and then identify three specific innovations that occurred within the selected case. They were then presented with lists of possible information sources utilised and difficulties encountered, and asked to rank each according to their relative importance.

The last set of questions was aimed at the overall process of innovation that the entrepreneurs experienced. These questions did not refer to specific innovations, but to the innovation process as a whole. Again, the respondent was generally presented with lists of a varying number of possible information sources and/or difficulties and asked to rank each according to its relative importance.

Surveys were mailed to the 28 policy entrepreneurs identified as part of the research and previously interviewed during the case study analyses; 24 responses were received. As surveys were returned to the authors, each respondent's answers were numerically coded and entered into a spreadsheet that was then directly imported into Statistical Package for the Social Sciences (SPSS) software for analysis.

The literature suggests that the variables about which survey questions were asked

were important in the innovation and social learning processes; however, there were no *a priori* assumptions regarding the relationship among the variables for any given question. Thus, a method of exploratory factor analysis, called principal component analysis (PCA), was used for this study. A separate PCA was carried out for the six questions on the survey pertaining to the variables identified in the literature.

For each question analysed, the results of the PCA are a series of factors that are constructed of the 'most important' variables for that particular question. The goal in constructing factors is to explain the most variance possible with the smallest number of factors.

These factors were then subjected to a reliability analysis to eliminate statistically suspect factors. Finally, new variables were constructed from the PCA factors remaining after the reliability analysis. These new variables were assumed to be standardised linear combinations of the variables contained within each remaining factor. The new variables constructed from the PCA analysis were then used in a linear regression to determine if these variables could predict entrepreneur response to certain survey questions.

Question 1 asked the respondents to rank the relative importance of different information sources in determining the nature of the problem (i.e. in problem definition). The statistical analysis resulted in one multivariable factor (problem definition factor), which was a combination of the following variables: academic journals; magazine articles; books; and specialised workshops. Relative to the other sources of information listed in the question, these four sources were regarded as the most important in defining the problem. It is interesting to note that 'discussions with experts' was not retained in the PCA analysis, given the important role of experts indicated in the literature. It would appear that expertise, while important in the overall innovation process, is not imperative in the problem definition phase, but that it becomes more important in the later phases such as seeking of solutions.

Question 4, which asked respondents to rank the importance of several barriers to innovation, resulted in a new barrier factor. This factor indicated the following variables as important barriers to the innovation process: lack of understanding of scientific/technical information (STI); solution required 'thinking outside of the box'; not enough time to adequately analyse STI; lack of organisational

diversity; lack of media support; lack of recognition; and fear of not being re-elected.

Four of the six variables found to be important barriers to innovation dealt with institutional structure. Two variables address the ability of the decision-making system to incorporate STI.

Research suggests that the ability to effectively incorporate STI is important for innovation and social learning to occur. The final two variables address more general institutional structure issues (diversity and 'thinking outside the box'). The literature suggests that entrepreneurs play a key role in altering the institutional structure such that these barriers to innovation are effectively removed.

Question 5, which asked entrepreneurs to rank the importance of several information sources in the search for new solutions, resulted in two new factors. The first factor consisted of the following variables: personal interviews with agency personnel; federal government sources; and expert opinions/guidance. This factor can be interpreted as indicative of the importance to the entrepreneurs of technical expertise. These findings affirm existing studies that explicitly address how technical expertise is incorporated into the innovation and social learning process.

A second search factor resulting from responses to *Question 5* was a combination of the following variables: private contract service and independent field reports. This factor consists of variables that are representative of outside expertise. As mentioned previously, it appears that the importance of outside experts lies in their ability to aid the entrepreneurs in their search for new solutions.

Question 6 asked the entrepreneurs to rank the importance of several factors in the process of adapting 'borrowed' solutions to Tulsa's situation, and resulted in an adapt factor composed of the following variables: personal interviews with agency personnel; personal experience and opinions; expert opinions/ guidance; and private contract service. Once again, these variables reflect the contribution of outside expertise to the innovation and social learning processes. Not only do experts serve as an aid to the entrepreneur's search for new solutions, but they are also important in helping them to adapt these solutions to their unique circumstances.

In *Question 8*, the entrepreneurs were asked if they felt the City of Tulsa had learned from its experience with environ-

mental policy innovation. If they answered 'yes', they were then asked to rate the relative importance of several variables relative to the city's ability to learn. A learning factor composed of the following variables: information analysis; information flow; and information use was constructed. This factor clearly shows the importance of STI in the innovation and social learning processes as discussed above. The entrepreneurs serve an invaluable role in the process of information flow and analysis.

Question 17 asked respondents to indicate the importance of several techniques that they learned during the innovation process and are currently applying to environmental policy initiatives and activities.

A factor consisting of the following variables was constructed:
- organisational flexibility; development of task forces
- public participation/support
- use of volunteers
- community involvement.

The variables retained in this factor are all reflective of the type of institutional environment and structure that the entrepreneurs believe is important in the innovation and social learning processes. Institutional structures should remain flexible, perhaps through the use of task forces developed to address specific concerns (such task forces would facilitate the inclusion of outside expertise). They also feel that it is important to build public support and community involvement, perhaps through the use of volunteers.

Regression analysis was performed to determine if the new variables could predict responses to specific survey questions. For example, *Question 2* asked respondents to indicate how quickly they became familiar with a problem (i.e. how quickly the problem was defined). Interesting questions to ask regarding this particular survey item are whether the type of information found to be important in problem definition or the barriers encountered are indicative of entrepreneur's response to this question. Only the barrier factor was statistically significant at the 0.05 level (significance = 0.013), indicating that the more important the barriers were considered to be, the longer it took the entrepreneurs to become familiar with the problem.

Question 3 asked the entrepreneurs to rate the ease with which solutions were found and adopted. The analysis suggested that the more important the entrepreneurs found the information used in problem

definition, the more difficult they found the adoption of solutions. Perhaps this is due to the fact that the more informed the entrepreneurs were regarding nature of the problem, the more they were aware of limitations regarding any particular solution.

The first portion of *Question 8* asked the entrepreneurs whether or not they felt the City of Tulsa had learned from its past experiences with environmental policy innovations. Interestingly, both the factors that the entrepreneurs felt were important in the city's ability to learn and those that they continued to apply in new policy-making situations were not indicative of whether the entrepreneurs believed the city had learned. While these are not the results one would initially expect to encounter, perhaps this is because of a discrepancy between the entrepreneurs' and the researchers' definitions of 'learning'.

Table 2 summarises the variables that the entrepreneurs found important to the innovation and social learning processes. These results support several tentative conclusions. First, the PCA underscored the importance of scientific/technical information (STI) and outside expertise in the innovation and social learning

processes. Not only must the entrepreneurs have access to STI, but it must be of a certain quality (i.e. it needs to be credible).

Expertise was seen as particularly important in the identification and adoption of new solutions, once the problem was well defined. The information used in problem definition was indicative of the difficulty the entrepreneurs encountered adopting new solutions. Also, barriers to innovation were indicative of the amount of time it took entrepreneurs to think they had clearly defined their problem.

Slight differences were seen between the three cases (Mingo Creek, municipal solid waste recycling, and ozone) for both the types of information used to define the problem and for the nature of the information used in the search for new solutions.

Discussion

The flood hazard case well illustrates the fundamental difference between environmental policy innovations and other kinds of innovations. The Tulsa case affirms Borin's (1998) general conclusions about environmental policy innovations and reinforces Deyle's (1994) suggestions

that environmental innovations necessitate a good deal more planning and policy analysis to reduce the relatively high degree of uncertainty that is systemic to environmental issues. The key to successful flash-flood hazard mitigation lies in its holistic, or drainage basin, approach that incorporates the essential administrative and managerial components needed to sustain the system.

In view of this finding, it is not surprising that the city opted to develop a new organisational structure to address its perennial flooding and related environmental issues. Also, the entrepreneurs worked quite well with environmental activists, several of whom were actively recruited by the city to implement the innovations

In addition, the stormwater utility fee was adopted by the city as a key user fee to support the effective management of the flood control program. Fourth, the case illustrates the significant degree to which politicians and public servants were involved, and the frequent, if not continuous, transboundary movements that they undertook within the city's administrative bureaucracy to get their innovations adopted and implemented.

While political leadership was uneven and inconsistent over a lengthy time period, several political entrepreneurs recognised the important role that executive entrepreneurs played in the adoption and implementation of effective solutions, and elected to work closely with them, both in the short and longer term planning horizons. Finally, the level of planning and policy analysis undertaken by the city, the USACE, and numerous consulting firms underscores the need for effective scientific and technical information to guide the design, development, and adoption of environmental policy innovations.

As a result of these attributes, a strategic approach, even one that is network-oriented, would appear to make a good deal more sense to policy entrepreneurs than to *grope along* in an attempt to motivate marginal changes that might ultimately prove to be ineffective. A strategic orientation also enables policy entrepreneurs to develop effective ways to address many of the impediments that would be expected to thwart an innovation. A review of the Tulsa story shows how most, if not all, of Altshuler and Behn's (1997) dozen impediments to innovation were successfully overcome. Lastly, the Tulsa story reinforces more general frameworks for understanding policy innovation while it illustrates the important contribution

Process	Important variables
Problem definition	academic journals magazine articles books specialised workshops
Barriers to innovation	lack of understanding of STI solution required 'thinking outside the box' inadequate time to analyse STI lack of organisational diversity lack of media support lack of recognition fear of not being re-elected
Search for new solutions	personal interviews with agency personnel Federal Government sources expert opinions/guidance private contract service independent field reports
Adapting borrowed solutions	personal interviews with agency personnel personal experience and opinions expert opinions/guidance private contract service
Ability to learn	information analysis information flow information use
Characteristics of learning environment	organisational flexibility development of task forces public participation/support use of volunteers community involvement accessing external information systems/holistic thinking

Table 2: Summary of Important Variables for Policy Entrepreneurs

that strategic entrepreneurship makes to our comprehension of the overall process, particularly in regard to environmental policy and our future prospects for attaining a more sustainable society.

The survey analysis of policy entrepreneurs underscores the importance of both STI and outside expertise in policy innovation. Entrepreneurs indicated that access to STI of sufficient quality allowed them to perform the more detailed planning indicative of the strategic innovation process. One manner in which STI can be obtained is through the cultivation of relationships with experts. The entrepreneurs who actively engaged in policy innovation have made it a point to seek out and nurture these relationships.

In light of its history of policy entrepreneurship, Tulsa's recent success with the Federal Emergency Management Agency's *Project Impact* is reflective of the lessons that the city's entrepreneurs and political leadership have learned from their struggles with natural hazard mitigation. The keys to Tulsa's success likely result from Mayor Savage's assignment of *Project Impact* to the Department of Public Works and the subsequent recruitment of seasoned policy entrepreneurs, such as J. D. Metcalfe, Charles Hardt, and Mike Buchert, to assist the local *Project Impact* coordinator, Ann Patton. Other entrepreneurs such as Ron Flanagan and former mayor Terry Young have signed on as project partners. Nevertheless, we also recognise that Tulsa's continuing success in policy innovation depends on community support and participation. The large number of partnerships the city has crafted underscore this point.

In regard to our understanding of the policy innovation process in Tulsa, there's much that needs to be better understood. While this article focuses primarily on the actions of individual policy entrepreneurs, it failed to investigate their organisational environments and the influence that policy-oriented learning might have on their structure and performance in regard to innovation. In addition, the rich social capital resources from which the city draws its support is an important, but understudied aspect of the city's ability to make continued progress toward sustainability. We would expect that future studies could examine the role of social capital (Putnam 2000) to community resilience and receptivity to innovation and change. This and related efforts in collaborative planning (Wondolleck and Yaffee 2000), for example, should improve our ability to manage our local urban economies and the environment more effectively in the future.

References

Altshuler A. A., & Behn R. D. eds. 1997, *Innovation in American Government.* Brookings Institute Press, Washington, DC.

Behn R. D. 1988, 'Management by Groping Along', *Journal of Policy Analysis and Management* 7, pp. 643–63.

Birkland T. A. 1997, *After Disaster: Agenda Setting, Public Policy, and Focusing Events*, Georgetown University Press, Washington, DC.

Borins S. 1998, *Innovating with Integrity: How Local Heroes are Transforming American Government*, Georgetown University Press, Washington, DC.

Buchert M. 1998, personal interview, July 21.

City of Tulsa 2000, *Building Bridges*, Tulsa *Project Impact*, Program Annual Progress Report, Tulsa, OK.

Deyle R. E., Meo M. & James T. E. 1994, 'State Policy Innovation and Climate Change: A Coastal Erosion Analog', in *Global Climate Change and Public Policy*, ed. D. L. Feldman, pp. 39–66, Nelson-Hall Publishers, Chicago, IL.

Deyle R. E. 1994, 'Conflict, Uncertainty, and the Role of Planning and Analysis in Public Policy Innovation', *Policy Studies Journal,* Vol. 22, pp. 457–73.

Federal Emergency Management Agency 2000, *Planning for a Sustainable Future: The Link Between Hazard Mitigation and Liveability*, Pub. No. 364, Washington, DC.

Flanagan R. D. 1998, personal interview, June 17.

Flanagan R. D. and Associates 1994, *Tulsa's Flood Management Program.* Planning Consultants, Tulsa, OK.

Golden O. 1990, 'Innovation in Public Sector Human Services Program: The Implications of Groping Along', *Journal of Policy Analysis and Management,* Vol. 9, pp. 219–48.

Greer D. 1999, personal interview, February 10.

Hardt C. L. 1998, personal interview, June 15.

Kingdon J. W. 1984, *Agendas, Alternatives, and Public Policies*, Harper Collins, New York.

Mazmanian D. A. & Kraft M. E. 1999, *Toward Sustainable Communities: Transition and Transformations in Environmental Policy*, MIT Press, Cambridge, MA.

McNeill N. 1999, personal interview, February 11.

Patton A. 1993, *From Harm's Way: Flood-Hazard Mitigation in Tulsa, OK,* Department of Public Works, Tulsa, OK.

Patton A. ed. 1994, *From Rooftop to River: Tulsa's Approach to Floodplain and Stormwater Management*, Department of Public Works, Tulsa, OK.

Polsby N. A. 1984, *Political Innovation in America: The Politics of Policy Innovation*, University of California Press, Berkeley, CA.

Putman R. D. 2000, *Bowling Alone: The Collapse and Revival of American Community*, Simon and Schuster, New York, NY.

Rabe B. G. 1986, *Fragmentation and Integration in State Environmental Management,* Conservation Foundation, Washington, DC.

Roberts N. C., & King, P. J. 1996, *Transforming Public Policy: Dynamics of Policy Entrepreneurship and Innovation.* Jossey-Bass Publishers, San Francisco, CA.

Sabatier P. A., & Jenkins-Smith H. C. 1993, *Policy Change and Learning: An Advocacy Coalition Approach.* Westview Press, Boulder, CO.

Stephan M. & Scheberle D. eds. 2000, Innovations in Environmental Policy Regulation and Management, *American Behavioral Scientist*, Vol. 44, No. 4, December.

Tulsa Partners 2000, *FEMA: Project Impact Recognizes City of Tulsa for Outstanding Efforts in Disaster Prevention*, November 17, www.tulsapartners.org.

Williams S. 1999, personal interview, March 1.

Wondolleck J. M. & Yaffee S. L. 2000, *Making Collaboration Work: Lessons from Innovation in Natural Resource Management*, Island Press, Washington, DC.

Ziebro B. M. 2000, *Social Learning for Sustainability: A Local Government Approach*, Dissertation, University of Oklahoma, Norman, OK.

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This article has been refereed