

HOW STEM POLICY INNOVATIONS RISE TO THE STATE HIGHER EDUCATION
GOVERNANCE SYSTEM'S AGENDA DURING A PERIOD OF ECONOMIC RECESSION:
AN ANALYSIS OF THREE STATES

by

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(Under the Direction of Erik Ness)

ABSTRACT

The economic downturn in 2007 forced higher education institutions and agencies to think strategically about how to support institutional missions and academic initiatives. The purpose of this dissertation is to describe how STEM innovations emerge on the state higher education agency agenda during a time of economic recession by focusing on the external influences that raise particular STEM innovations to the state policy agenda. Through a comparative case study of three states at different stages of policy innovation, including one state viewed as a “non-adopter,” the view of policy leaders on the role of national and regional networks in guiding practice is examined. These cases describe the internal and external influences on STEM innovations through a narrative chronology of events and analyze the diffusion of innovations using two diffusion theories – national interaction model and regional diffusion. A third theoretical framework used to guide this study, institutional theory, describes state level discourse as it relates to the neoliberal ideology guiding state governing boards in STEM policy innovation. Findings identified how federal incentives and national professional networks shape policy leaders’ opinions on STEM innovations.

INDEX WORDS: higher education, governance, state policy, STEM, innovations, diffusion

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A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial

Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2013

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May 2013

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For my son, Braden William Leming (June 16, 2009 – June 26, 2009),
whose memory gives me daily inspiration to persevere against all challenges I face in my life.

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the love and support of my family. My husband, Marc, who has stood beside me through challenging times and provides reality checks so that I never take life too seriously, thank you. My parents, Ron and Marsha Scheusner, and brother, Geoff, who always provide a “safety net” that allows me to take chances and gave me comfort when I felt alone, I love you.

Heartfelt thanks and appreciation to Stephanie Hazel, Jennifer Olson, and Lauren Collier who gave me emotional and academic support throughout my two years of coursework and became my cheerleaders as I moved through the dissertation process. I am forever grateful that I found such emotionally intelligent women immediately upon my arrival in Athens. You made all the difference.

I feel privileged to have had the opportunity to learn from excellent faculty at the Institute who shaped my intellectual understanding of higher education and what it means to be a consumer of knowledge. In particular, I want to thank Dr. Jim Hearn and Dr. Sheila Slaughter who served as academic icons for me and Dr. Erik Ness, who brought state governance and policy discussions to life in the classroom, and who I look up to as my academic mentor. Thank you for your care, concern, critical feedback, and professional support as I moved back into the working world.

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CHAPTER 1

INTRODUCTION

Context

The U.S. system of higher education differs from other global higher education systems in that the state institutionalized the study of science and creation of scientific research/technology within the higher education structure as early as WWII (Altbach, 2005). The institutionalization of science and scientific research within higher education linked higher education to the economy. This led to the innovation of knowledge networks that helped to perpetuate connections between higher education, private industry, and the government. Furthermore, in the 1960s, the restructuring of higher education (which was in an effort to create greater accountability to taxpayers), saw a growing emphasis on public-private partnerships in research (Altbach, 2005). As a result, state leaders have come to view higher education as one major policy sector in which states can leverage for economic development and for the achievement of state economic goals.

While states have developed initiatives to tie higher education to economic goals through public-private collaborations, state systems for higher education have also evolved in response to economic pressures. The shift towards privatization in higher education is the result of increasing competition for resources and efforts to enhance institutional prestige (Bok, 2002; Kirp, 2003; Mingle & Epper, 1997; Morpew & Eckel, 2009). The historical shift towards privatization and deregulation of state systems of higher education began in the 1990s (Mingle & Epper, 1997). During this time, the focus on “reinventing government” resulted in greater

emphasis on market-driven decisions and competition between states for resources. Mingle and Epper (1997) argue that as state government moves away from financing a larger share of the postsecondary expenditures, there is greater competition between institutions for resources. This competition moves institutions towards innovations funded by federal and private grants.

In 2009, the Obama administration worked with Congress to pass an economic stimulus bill, the American Recovery and Reinvestment Act (ARRA), which provided \$787 billion in federal funding to bolster state budgets. In the initial year, stimulus funding went to offset budget shortfalls with over \$100 billion going specifically to the U.S. Department of Education to provide assistance to states in the form of state fiscal stabilization funds, student financial aid, and other formula grant programs (U.S. Department of Education, 2009). A primary intent of the ARRA was to provide the foundational support needed for education reform, particularly in the areas of educational innovation, and included \$21.5 billion in funds for scientific endeavors (U.S. Department of Education, 2009).

One component of the ARRA is the “Race to the Top” (RTTT) grant program. This grant program has four core areas in which states were to implement educational reform: (1) internationally benchmarked educational standards; (2) teacher recruitment and performance incentives; (3) statewide student performance data systems; and (4) improvement of low-performing schools. One of the grant criteria included an emphasis on science, technology, engineering, and mathematics (STEM). Specifically, the RTTT grant encouraged applicants to identify cooperative partnerships with industry, universities, research centers, and other STEM-capable community partners to enhance course curriculum and improve student preparation for entry into STEM fields (Department of Education, 2009).

Since the U.S. is falling behind its international competitors in terms of the number of citizens obtaining a postsecondary degree, the U.S. has lost ground internationally in its ability to be competitive in science and technology. The long-term impact to the U.S. will be its inability to compete in a growing knowledge-based, global economy. As such, a major policy focus of the Obama administration was to create incentives to boost innovations in education and STEM fields. With the 2007 economic crisis in the U.S., financial incentives offered by the federal government to states encouraged even greater support for state involvement.

Problem

The economic downturn in 2007 forced higher education institutions and agencies to think strategically about how to support institutional missions and academic initiatives. A large body of literature examines the role that declining state funds have played in forcing institutions to seek out other revenue streams (Dill, 2003; Ruppert, 1996). Governors and legislatures realize that higher education has other revenue sources (tuition, fees, donations, etc.) and therefore use higher education as a “budget balancer” (McGuinness, 2005). As a result, higher education must maximize its share of state resources. McLendon, Heller and Young (2005) describe how the state has two primary relationships with higher education: (1) to maintain assets of higher education and (2) to acquire assets needed by the state. As the economic recession of 2007 took hold in the U.S., states increasingly looked for innovations that could maximize state economic interests as well as provided federal and private funding opportunities to offset budget shortfalls. Since state leaders view higher education as a major policy sector for economic growth, state systems have been called upon to engage with other state agencies in developing economic initiatives that build the state’s capacity for attracting industry through research innovations and

workforce preparation. Thus, states use federal funding to maintain higher education spending while also leveraging these funds to expand the state's economy.

Higher education governance systems also have their own motivations to innovate in the areas of science, technology, engineering, and math (STEM). First, the state higher education agency is motivated to acquire greater resources (federal or private) on behalf of the state and the institutions under its control. External pressures to compete nationally and globally demand strategies to make a state more competitive. Internal pressures by higher education institutions and private industry demand access to resources that allow internal stakeholders to increase revenue and prestige. Because of these external and internal pressures, the state higher education agency is motivated to coordinate STEM innovations in order to maximize the efforts of institutions under its jurisdiction. Competition between institutions, either within a state or between institutions and the governing board, can affect policy innovation decisions (McLendon & Ness, 2003). Therefore, a coordinated approach maximizes funding opportunities by building cooperative partnerships within the state system as well as curtails competition between institutions within a state – leveraging particular institutions to be in a more favorable position to receive STEM-related resources.

While the research literature on state governance and policy innovation has grown in the last 20 years, there are still many limitations to the research - leaving room for further exploration. Despite the growing number of studies on the effects of higher education governance structure, no clear trends on policy innovation emerge. For example, studies that examine the impact of governance structure on funding innovations yield contradictory results. Furthermore, there is inconclusive evidence on the role that certain political and socio-economic factors play on postsecondary policy. As Ness and Mistretta (2009) illustrate in their study of

state lottery beneficiaries, the existence of economic distress and the influence of a state's unique political culture at the time of the innovation can also be factors that influence a policy outcome. Therefore, the study of policy innovation at a time of economic distress may yield differences in state-level innovations than compared to innovations at other periods in time.

While there have been studies that examined the factors that influence policy outcomes and the role that the higher education governance structure plays in policy decisions, researchers have paid little attention to how STEM innovations come to be on the state higher education agency agenda. Thus, it seems that a study of the external factors, which shape STEM innovation during a period of economic crisis, would serve to compliment previous policy innovation research.

Purpose and Research Questions

The purpose of this dissertation is to describe how STEM innovations emerge on the state higher education agency agenda during a time of economic crisis. The intent of this case study is to focus on the external influences that raise particular STEM innovations to the state policy agenda.

Previously, researchers utilized a variety of theoretical frameworks in studies on state policy innovation. Within this study, I employ the national interaction model and regional diffusion model in order to examine more fully the extent by which the federal government, professional associations and neighboring political leaders influence STEM innovations on a state-level. I utilize a third framework, institutional theory, to examine the standardization of practices through legislation, rules, and norms that may influence state-level STEM innovations.

The two overarching research questions guiding this study lead to a descriptive understanding of the process through which STEM innovations emerge and reveal implications for policy innovation theories.

1. How does STEM policy come to be on the state higher education governing board's agenda?
 - a. How did ARRA funding encourage particular STEM policy initiatives?
 - b. How did a state's level of involvement in RTTT influence STEM policy initiatives? What were the differences between policy adopters and non-policy adopters?
 - c. Why did each state choose the emphasis on the STEM innovations that it did?
 - d. How do various state-level organizations influence this process?
2. How do three theoretical models – national interaction, regional diffusion, and institutional theory - explain STEM policy activity in the states?

Significance and Implications

Since governance arrangements serve to institutionalize decision-making and preferences of stakeholders (McLendon, Deaton, & Hearn, 2003), the continued study of governance structure on policy innovations is an area worth further exploration. When looking at governance structure, researchers should account for the current economic conditions within a state and political forces at work external to the governing board. A holistic approach may also shed light on how internal and external actors work together to shape policy innovation, rather than an “either/or” perspective.

A review of recent literature of state governance structure on policy outcomes has primarily examined the significance of governance structure on higher education finance innovation (Hearn, Griswold, & Marine, 1996; McLendon, Hearn, & Deaton, 2003; Zumeta, 1996). At the same time, there have been researchers who have found no significance between governance structure and finance innovation (McLendon, Heller, & Young, 2005; McLendon, Hearn, & Mokher, 2009; Volkwein & Tandberg, 2007). These findings while important to the study of how governance shapes innovation, do not offer any implications for how state leaders might shape STEM innovations, or if there are differences by governance structure.

The use of additional theoretical frameworks in explaining the policy innovation process deserves further development and examination as well. Often, studies only explore enacted policy innovations, policy adoptions, and the influence this has on neighboring states. Another approach could be the study of non-policy adopters similar to the work of Ness and Mistretta (2010) who studied North Carolina's rejection of using lottery revenue to fund a state, merit aid program. The information utilized in the decision-making process that discourages states from emulating another or in "bucking the trend" can provide insight into how internal actors view the role of national and regional networks in guiding practice. This study examines states in three different phases of innovation based on their participation in RTTT, from the earliest adopter to a non-adopter. This work would expand upon the understanding of how non-policy adopters differ either in their resistance to external influences or in their approach to the innovation process.

Additionally, a descriptive examination of the opinions and decision-making of key actors in the initial innovation proposal would add rigor to the study of policy innovation. Through a more in-depth examination of how innovations come to be on the state higher education agency agenda, this study identifies how national professional networks and informal

connections with leaders within a similar region shape political leaders' opinions. Ultimately, this data provides useful information on how professional networks play a greater role in institutionalizing specific practices than originally imagined. As behaviors gain in acceptance as the "way things are done," evidence of the institutionalization of STEM innovations reveals how federal funding not only incentivizes states to enact particular STEM innovations, but also systematically changes the way in which professionals think about STEM innovations.

This study also contributes to the body of literature that conceptualizes higher education institutions as economic engines for the development of a state's economy, connecting with business and industry to build new revenue streams for the state (Geiger & Sá, 2005; Hearn, McLendon, & Lacy, 2009; Pusser, Slaughter, & Thomas, 2006). Several researchers have examined the role state government plays in promoting technology transfer and innovation among its institutions (Geiger & Sá, 2005; Hearn, McLendon & Lacy, 2009). Through this study's exploration of state leader's opinions and decision-making in the innovation proposal phase, this study aims to inform policymakers and researchers of how the economic recession becomes a rationale to engage in certain state-level STEM innovations.

CHAPTER II

LITERATURE REVIEW

Overview

For purposes of this study on STEM policy in the states, the phrase “policy innovation” is defined as a program that is new to the government adopting it, but it may have been adopted by other governments prior (Walker 1969, p. 881). Using this definition, I pay attention not to the origination of the policy, but the process by which the policy ideas are derived (Berry & Berry, 2007). McLendon (2003) provides two explanations for the adoption of new policies within higher education: (1) internal determinants like social, economic, or political factors, and (2) diffusion models where states emulate the policies and practices of neighboring states. Two key theories of government policy innovation examined in the research literature and employed in this dissertation include regional diffusion model and national interaction model. A third theoretical lens, institutional theory, is applied to this study in order to examine how a state’s policy innovation may become viewed as “standard” or “accepted” as a result of federal legislative actions.

Impact of State Governance Structure on Policy Adoption

Each type of state governance structure represents a level of campus autonomy and state control on a continuum, with voluntary boards having the greatest level of campus autonomy and consolidated governing boards having the greatest level of state control. A review of recent literature on state governance structure on policy outcomes has primarily examined the role of governance structure on higher education finance innovation (Hearn, Griswold, & Marine, 1996;

McLendon, Hearn, & Deaton, 2003; Zumeta, 1996). Weerts and Ronca (2006) concluded that consolidated governing boards have greater authority, innovation, and success in meeting the state's needs and these factors influence the decision-making process. These findings support the claim made by McGuiness (1988) that centralization of higher education governance is associated with greater rationalization of decision-making and identification of system needs, as well as makes the governance structure more resistant to change. Zumeta (1996) looked at funding models and then compared them to the state's governance structure and concluded that consolidated governing boards act like "cartels" because they protect their own self-interests instead of representing the state's needs. The result is that these structures spend more.

In contrast to these earlier studies, however, there have been researchers who have found no significance between governance structure and finance innovation. McLendon, Heller, and Young (2005) found a weak connection between structure and financing innovations. McLendon, Hearn, and Mokher (2009) also failed to identify any variation between states when examining governance structure and financing. Volkwein and Tandberg (2007) found no relationship between structural organization and the quality of education offered (as measured in the annual *Measuring Up* report). Instead, their findings suggested that the only significance was a negative correlation between governance structure and the state's grade on the *Measuring Up* report in the areas of affordability and benefits.

In studies that examine state governance structure, researchers look at the role of political factors on how members make decisions within a particular governance model. McGuiness (1988) states that consolidated governing and strong coordinating boards are more likely than other governing structures to produce significant innovations. Coordinating boards are associated with greater objectivity, while at the same time more closely aligned to the state

legislature. Nicholson-Crotty and Meier (2003) argue that structure affects how political forces influence higher education. The researchers propose that since political interests set rules and advantage one group over another, that these external pressures will influence the governance structure's decision-making processes. For example, consolidated governing boards are less likely to be politically influenced because they have greater constitutional autonomy while at the same time are more closely aligned to the institutions under their control. Whereas, coordinating boards are closely aligned to the state because they lack corporate status (autonomy) and have varying degrees of budget authority as decided by the state's legislature.

Researchers have also examined compatibility between the governance structure and the policy environment in order to measure system effectiveness (Martinez, 2002). In the end, however, researchers have found little to link a particular governance structure to more effective policy innovation. Only studies, which look at the likelihood of policy adoption, have found connections between particular governance structures, but again these influences varied and political reasons influenced the policy direction taken (McLendon, Hearn, & Deaton, 2006).

STEM Innovations

Several researchers have examined the role state government plays in promoting technology transfer and innovation (Geiger & Sá, 2005; Hearn, McLendon & Lacy, 2010). The inclusion of the private market in higher education has placed pressure on state policymakers to decentralize and enter into technology and scientific research in order to compete nationally and globally. The National Governors Association (NGA) outlines several state strategies which leverage university research to promote state economic growth including: connecting faculty with local entrepreneurs, technology transfer, state financial investment in university research, and financial incentives for faculty whose discoveries lead to start-up companies (NGA, 2011).

As an example of how states are institutionalizing technology-based economic development policies, the NGA “Innovation America” initiative provides state governors with best practices on effective policies and strategies to align higher education with state economic goals (NGA, 2007). All of these strategies are used by policy makers in the hope that investment in research structures will result in technological innovations which will increase tax revenues which can later be used to increase state expenditures for education. Coburn and Brown (1998) argue that these strategies also have negative consequences including: the creation of an “economic war” between states – where one state’s incentives push others to do the same.

States have two strategy choices related to STEM innovations: policies to promote technology creation or policies to facilitate the transfer of technology to the private sector. The National Science Foundation Engineering Research Centers (ERC) are just one example of a federal initiative in the 1980s to create technology. The ERCs engaged faculty in interdisciplinary research related to engineering problems with the original intent of engaging in more long-term, non-commercially related research. On a state level, an early leader in the promotion of technology creation was the State of California. In 1981, California supported research in microelectronics technology and computer sciences through a public-private partnership between the University of California System and the Microelectronic Innovation and Computer Research Opportunities Program (Lyall, 1986). Another example held up as an effective technology creation policy is the Georgia Research Alliance (GRA), an intermediary organization that “brokers” deals between university-based research and private industry, with state funding used to facilitate private investment (Geiger and Sá, 2005). The GRA hosts an “eminent scholar” program where states hire star faculty members to assist the GRA in its efforts (Hearn, McLendon & Lacy, 2009). The State of Michigan provides an example of how a state

may create a center of excellence/research institute that houses professors in fields relevant to a state's economy. The idea of centers has been around for some time now and is an established practice in which a state encourages technology creation. For example, Michigan created a Biotechnology Institute in 1983 to foster commercialization of biotechnologies and used start up funds provided by private foundations and the state's Economic Development Authority. Other examples include North Carolina's research triangle and the Ben Franklin Partnership program in the Commonwealth of Pennsylvania – one of the most frequently cited success stories in the research literature (Lyall, 1986). While technology creation and technology transfer are two separate processes, many initiatives combine them into a seamless programmatic effort.

There are several ways that institutional leaders use faculty research to generate revenues for the university: technology transfer offices, patents and licensing, university-business partnerships (like business incubators and firms, research parks, start up firms), and fee based services (Hearn, 2003). Institutional and state leaders, however, drive these structural reforms with state initiatives closely intertwining with institutional efforts. Since higher education is a political institution, universities not only facilitate innovation for their own purposes, but also serve as mechanisms themselves for the achievement of state economic goals.

Policy Innovation & Diffusion Theory

Diffusion research seeks to identify conditions that drive the spread of new policy ideas. Three researchers create the foundation of policy diffusion literature Walker (1969) who conceptualized the first model and conducted the first diffusion tests; Gray (1973) who identified an S-curve pattern in policy adoptions by policy topic; and Berry and Berry (1990) whose study of state lottery adoption factored internal and external determinants into a single model.

As Rogers (2003) states, “Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system...it’s a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system” (p. 5-6). Diffusion models explain how members of a particular professional or social system communicate about innovations through informal and formal channels over time (Berry & Berry, 2007). First, states learn from each other as they see what innovations result in successful outcomes and then state leaders borrow the idea for implementation within their own state. The social system is “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal,” (Rogers, 2003, p. 23). Therefore, the structure of a social system can either facilitate or impede the diffusion of the innovation. In the same manner, a system’s norms can guide what is “acceptable” or become a barrier to change.

Regional Diffusion

Walker (1969) tested the relationship between policy innovations and a variety of state-level political indicators and found a positive correlation with state-level policy innovation. He also found that some states serve as “regional pace setters” and for the most part states cluster into “regional reference groups.” As such, scholars continue to use geography to examine policy innovation. State policy makers face normative pressures to be similar to their “neighbors” while at the same time must satisfy in their decision-making due to limitations on their time and information asymmetry. This leads policymakers to look to neighboring states due to a belief that there is commonality in cultural, demographic, educational, or economic conditions. Furthermore, proximity facilitates avenues of communication that support the

transfer of policy ideas. As competition between institutions and between states for resources has grown, this competition for resources drives states to innovate.

Researchers have used regional diffusion models to explain policy innovation behavior with mixed findings (Berry and Berry, 1990; Berry, 1994; McLendon, 2003; McLendon, Heller, & Young, 2005). A case study by Frost, Hearn, and Marine (1997) found state-level decision-making is based on a combination of time limitations, political pressures, bureaucratic structures, and public opinion. Doyle (2006) discovered that when large numbers of students left their home state to attend elsewhere due to cost, states were more likely to adopt merit-aid programs in order to retain students. McLendon, Heller, and Young (2005) found states tend to emulate financing policies of neighbors. In fact, the researchers found diffusion to be a better predictor than internal determinants. In contrast, McLendon, Hearn, and Deaton (2006) hypothesized that states would try to emulate each other due to interstate competition. When they examined the spread of state performance-budgeting policies, they found little evidence to support the idea that diffusion played a role in a state adopting such policies. Instead, the researchers found that governance reform was due to a host of external events including, but not limited to, public concerns over rising tuition, growth in enrollment, accountability and efficiency, and political turbulence. McLendon and Ness (2003) also found diffusion to be a relatively insignificant factor in a state deciding to adopt the governance arrangements that it did, concluding that political actors had the greatest influence on the policy process. More recently, Ness and Mistretta (2010) conducted an in depth analysis of why North Carolina did not allocate lottery revenues to a merit aid program similar to the other seven Southeastern states surrounding it. Their findings suggest that internal characteristics of the state mitigated the influence of surrounding states from taking hold in North Carolina.

Internal Determinants

Berry and Berry (1990) combined the internal determinants model with the regional diffusion model using Event History Analysis (EHA). Berry (1994) uses three theoretical propositions in the study of diffusion as examined through EHA: 1) Cross-sectional analysis for internal determinants; 2) factor analysis for regional diffusion; and 3) time-series regression for national interaction. Several studies have examined the role that internal determinants play in shaping state action in educational policy and postsecondary policy in particular. These internal determinants include socio-economic, cultural, and political factors (Berry & Berry, 1990; McLendon, 2003; McLendon & Hearn, 2007). Doyle (2006), found states that had lower educational attainment among its citizens increased the likelihood that the state would adopt a merit-aid program. McLendon, Hearn, and Mokher (2009) used state demography, among other variables, to examine state funding for higher education and found a positive relationship between demographic factors to funding, with a more educated and wealthier citizenry predicting higher appropriations. In a study by Hearn, Griswold, and Marine (1996), the economic condition of the state served as a proxy for social values and attitudes along with state resources (like size of the state, citizens' educational attainment, and citizens' income levels) and governance structure to determine the relationship between these three factors on state tuition and student aid. Findings from their study suggest that social values, which the public associates with higher education, may influence policy innovation directions. Competition between institutions within a state or between institutions and the governing board is another factor identified as affecting policy innovation (McLendon & Ness, 2003). Squire (2007) examined legislative professionalism, a measurement defined by the extent to which legislators have access to staff resources, level of pay, and time demands of service, and concluded that the level of

professionalism of state legislators should be considered as an internal determinant of the policymaking process.

National Interaction Model

Gray (1973) expanded on Walker's work, particularly in the area of the role of federal intervention on states' decision-making. She contributed to the diffusion literature by looking at how time and issue topic (whether there is a federal involvement) influence the direction of state policy innovation. Since then, researchers have used the national interaction model to explain how a particular postsecondary policy comes to be on a state's agenda. This model illustrates how the federal and national professional networks can influence policy proposals (Berry, 1994). The national interaction model assumes that as the frequency of interactions increases between professionals and state officials within certain networks, the more likely those other states will adopt similar policies based on the interactions with these members. Walker (1969) concluded that pressure from the federal system for a state to conform to national standards is another means by which states look to those who have already adopted a particular innovation. Berry (1994) argues that while it is safe to assume that officials between states interact, officials from some pairs of states are more likely to communicate more frequently than other states.

Only a few studies have examined the role of national associations on higher education governance systems. These associations include officials who are members of the National Governors' Association and the National Conference of State Legislatures. For example, Gray (1973) situated her study to be an examination of several state policies adopted across all 50 states. She hypothesized that the adoption rate of these policies were proportional to the number of interactions that state officials had with states who were already adopting the particular innovation under consideration. Admittedly, the difficulty in using national interaction models,

however, is its treatment of states as undifferentiated in terms of other characteristics. Logically, there is a pattern in interactions between certain state officials, and therefore, an examination of regional influences can yield more information that is applicable.

Institutional Theory

A third theoretical framework used to guide this study is institutional theory. Institutional theory places an emphasis on how rules, norms, and routines build social structures. Through the creation and adoption of certain ways of doing things, the actions become legitimized by individual units and later by the larger group. Within each institutional sector, organizations seek legitimacy in order to survive. Both cognitive and cultural considerations for social ordering take place as rules and norms are developed. As a result, other organizations, which evolved from different means, begin to emulate successful organizations through the adoption of similar rules and norms - referred to as “institutional isomorphism.” All of the institution’s rules and norms place expectations on and influence the actors within the organization. Over time, institutions assimilate expectations for behavior or cognitive rationale in such a way that individuals come to take the expectations for granted and act in the socially accepted way without thinking about it.

Colyvas and Powell (2006) argue that through the self-reinforcing feedback of individuals, which leads to greater legitimacy and taken-for-grantedness, institutionalization occurs. The researchers define legitimacy as beliefs, norms, and rules that people use toward a common purpose, which over time are reciprocally interpreted (Colyvas & Powell, 2006, p.309). Therefore, as one process is negotiated and common language and behaviors are accepted by both parties (codified), the action gains in its legitimacy and moves into a state of general acceptance as the “way things are done.” The researchers conclude that when legitimacy is low,

there is a need to illustrate the public benefit of such an activity in order to gain support beyond the organization. In the next stage of development, standardization of behavior results from a common understanding of the purpose or values behind the actions. The actions also gain socio-political legitimacy at this point through the development of legislation, laws, or rules that guide the actor's behavior. In the final stage of development, cultural-cognitive legitimacy occurs when the actors accept the behavior as something that is preferred and even respected as a course of action. Within this final stage, the researchers conclude that very little articulation is necessary.

On a micro-level, Powell and Colyvas (2008) illustrate how everyday processes and organizational members (who are not leaders) play an important role in organizing daily activities, problems, and answers which provide the foundation of standardized processes and shared meanings later taken-for-granted. Therefore, localized attention within a specific organization can illustrate how members provide continuity and prompt shifts in practice. Two building blocks form the basis for analysis on a micro level: a “build up” focus (where discourse rises from within the membership to become acceptable practice among institutional leaders) and a “pulled down” effect from the macro level (where administrative heads or the larger umbrella organizations dictate the implementation of practice as an acceptable behavior) (Powell & Colyvas, 2008).

The basic premise of institutional theory is that an organization's survival depends upon its ability to conform to social norms of acceptable behavior and high levels of efficiency (Covaleski & Dirsmith, 1988). At the same time, organizations can serve as entrepreneurs in policy formation, but once the organization obtains success, others may attempt to emulate the initial policy innovator. DiMaggio and Powell (1983) describe three ways in which isomorphism

occurs: through coercive isomorphism (pressures from external constituents to adopt bureaucratic processes), mimetic isomorphism (imitation of widely used organizational practices), and normative isomorphism (professionals circulate within their own systems and share best practices).

Researchers use diffusion theory to explain how states adopt initiatives and policies of initial policy adopters. Diffusion theory, however, differs from institutional theory in a significant way. Many policy initiatives can spread, but without becoming institutionalized. The difference is in whether the policy persists. Therefore, researchers must make a distinction in their analysis on the character of the policy adoption. Colyvas and Johnson (2011) examine the differences between the two and the degree to which institutionalization influences diffusion. The researchers conclude that institutionalization contains cultural and cognitive frames that lead to reproduction and integration while diffusion explains how something spreads between organizations (Colyvas & Johnson, 2011).

As such, institutional theory can be a useful framework in examining state level discourse as it relates to the neoliberal ideology guiding state governing boards in STEM policy innovation. Covalleski and Dirsmith (1988), for example, used institutional theory to examine the budgetary relationship between the University of Wisconsin and the state during a period of economic recession. They defined institutionalization as the “process by which societal expectations of appropriate organizational form and behavior come to take on rule-like status in social thought and action” (p. 562). Their findings explain how political and societal expectations during a budget crisis can force institutions to conform to organizational rules (illustrating the “pulled down” effect from the macro level).

CHAPTER III

RESEARCH DESIGN

Research Strategy

Yin (2009) suggests that the degree of focus on contemporary events dictates the researcher's use of case study methodology. In deciding which case study model to use, researchers view multiple comparative case study models as more robust than single case studies (Creswell, 2007). Furthermore, when examining state policy innovations, researchers often use comparative case study models in order to test and expand conceptual frameworks to explain the policy innovation process (Leslie & Novak, 2003; McLendon, 2003; Ness & Mistretta, 2009). Comparative case studies allow variables to emerge and provide data on which the researcher can conduct state-to-state analyses, allowing any and all explanations on how policy innovations emerge onto the higher education governing boards' agenda.

Previous research on policy innovation has used quantitative and qualitative methods to examine differences among states in policy innovation (McLendon, Deaton, & Hearn, 2007; McLendon, Heller, & Young, 2005; Nicholson-Crotty & Meier, 2003; Volkwein, 1987). This study differs from previous research by utilizing a case study design similar to the study by McLendon and Ness (2003). As such, I deliberately selected cases so that they represent contrasting situations. Thus, each individual case study is considered the "whole" study and direct replication between cases is not required (Yin, 2009).

I bound this dissertation in time to higher education innovations in STEM after the 2007 economic recession. By far, the most impactful federal response to the 2007 economic crisis is

the enactment of the 2009 American Recovery and Reinvestment Act (ARRA). In spite of national budget cuts during this time, the National Science Foundation (NSF) reported increases in federal expenditures in R&D. In 2009, for example, the NSF reported an 8.8% growth in federal R&D expenditures over 2008 expenditures. This growth is due largely to the fact that the federal government directed all agencies to allocate ARRA funds by FY 2010 (Yamaner, 2011). The influence of the ARRA on state higher education spending and policy innovations in STEM has yet to be fully analyzed beyond the mere reporting of federal dollars allocated by federal agencies to states through grant programs. An initial analysis of data indicated that the primary method by which the federal government distributed research funds to states was directly to higher education institutions, not the state itself. Since this study was concerned with state-level initiatives influenced by ARRA/RTTT funding, federal research funding in STEM, which flowed directly to postsecondary institutions, did not fall within the scope of this study.

Sample Selection

The use of a qualitative research design which follows Yin's (2009) replication approach utilizes a theoretical framework which guides selection of cases that either provide support for propositions that can be replicated in future studies or provides contrasting results, but for anticipatable reasons - a "theoretical replication" (Yin, 2009, p. 54). A researcher employs purposeful sampling when the illustration of different perspectives is desired (Creswell, 2007). This dissertation utilized purposeful sampling of multiple cases studies with contrasting inputs in order to use the theoretical framework to generalize findings to additional cases.

I employed four criteria to select case study states. *First*, only states that are members of the Southern Regional Education Board (SREB) were considered. This criterion ensured that regional similarities were accounted for and allowed for examination of the influence of regional

policy diffusion. *Second*, states must not have institutions listed in the top 20 of federal R&D in 2009 (the most current year available at the time of the research proposal and the same year in which the ARRA was authorized). This ensured that states selected had postsecondary institutions that were somewhat similar in the level of federal support received for R&D in STEM fields at the outset of ARRA funding availability. *Third*, each state must differ in its governance structure for higher education. This criterion achieved maximum variation among the sample states in order to examine the role of governance type on policy innovations. *Fourth*, the focus of this study was to examine policy innovations in STEM from 2007-2013 in order to provide parameters for examination among the cases (from the beginning of the economic crisis to the end of the four-year grant timeline provided by ARRA's "Race to the Top" initiative). Therefore, a state must have participated in the RTTT grant application during the first phase of awards. While federal government reporting on the allocation of ARRA dollars to higher education institutions for STEM-related research provides one measure, the data only reveals the STEM policy initiatives of specific postsecondary institutions within a state. A second measure of STEM related policy initiatives resulting from RTTT funding, employed here, reveals how national and regional influences affect STEM innovations on a state level. This final criterion bounded the case studies to the influence of the RTTT competition on higher education STEM innovation.

The RTTT fund was a \$4 billion grant to support innovations to improve schools with a major focus of RTTT on STEM education, the creation of statewide student performance data systems, and alignment between all sectors of the state's education system. I viewed the influence of federal funding received from RTTT as an independent variable that should be accounted for when examining how and in what ways ARRA funds influenced STEM

innovations in higher education at this time. Out of phase one grantees, the U.S. Department of Education selected two states: Tennessee and New Hampshire. In the second phase, nine states and the District of Columbia were awarded grants. The nine grant recipients in the second phase included: Massachusetts, New York, Hawaii, Florida, Rhode Island, Maryland, Georgia, North Carolina, and Ohio (U.S. Department of Education, 2011). Based on the previously mentioned criteria and the desire to select states which represent the different phases of RTTT funding, one state that received funds during the first round (TN), one state that received funds from the second round (GA), and one state that applied in the first two phases but did not receive funds (SC) yielded the comparison information desired to test the national interaction model. Table 1 summarizes the characteristics of each state selected for this study.

Table 1. Summary of Sample States

State	Governance Type*	FY09 Federal R&D in top 20	Race to the Top Winner
Georgia	Consolidated Governing	none	1 st round applicant, 2nd round winner
South Carolina	Coordinating Board ++	none	1 st and 2 nd round applicant, non-recipient
Tennessee	Coordinating Board +	none	1st round applicant and winner

*As classified by McGuiness, A.C. (1988). *State Postsecondary Education Structures Handbook*. Denver, CO: Education Commission of the States.

+Budget review and recommendation

++Consolidated or aggregated budget

Georgia

The Board of Regents for the University System of Georgia is a consolidated governing board with oversight for all 31 public institutions within the state, but with no oversight over the technical college system. No public institution within the State of Georgia was ranked in the top 20 of institutions receiving federal R&D funds in 2009. Georgia made an initial application for RTTT funds, but was not selected. In the second round of applications, Georgia was awarded \$400 million to implement its RTTT reform plan, which establishes Georgia's Innovation Fund. Georgia designed its fund to encourage institutions to implement reforms focused on: better preparation of students for college and workforce development, teacher preparation, and STEM education. Georgia created a competitive grant process to encourage innovations with an emphasis on creating collaborations between K-12, higher education, and business organizations (State of Georgia, 2011). In addition to RTTT funds, the State of Georgia utilized ARRA funds to expand NIH and NSF research opportunities among its higher education institutions (State of Georgia, 2011).

South Carolina

South Carolina's Commission for Higher Education is a coordinating board with consolidated budget authority over all 17 public institutions in the state and 16 technical colleges. No public institution within the State of South Carolina was ranked in the top 20 of institutions receiving federal R&D funds in 2009. South Carolina applied for RTTT funds in the first and second rounds, but was not selected. After the second round, the South Carolina Superintendent of Education, Mike Zais, publicly announced that the state would not continue to seek RTTT funds since the program, "expands the federal role in education by offering pieces of silver in exchange for strings attached to Washington" (The State, May 25, 2011).

Despite South Carolina's withdrawal from the RTTT funding competition, the state still benefited from ARRA funding. Direct funding from the NIH to state institutions reached \$184 million in 2009 (Battelle, 2010). One specific example was the successful bid by Clemson University for a \$45 million Department of Energy grant to develop wind turbines (The State, April 18, 2010). In 2009, the General Assembly appointed the Higher Education Study Committee to recommend a statewide higher education master plan which includes a goal focused on increasing research and innovation, but specific initiatives related to STEM innovations from the state higher education agency level have yet to be identified (SC Commission, 2011). As such, I viewed South Carolina within this study as a "non-adopter" in order to compare differences in STEM policy innovation because they did not secure RTTT funding and their state agency for higher education implemented no STEM innovations during this period.

Tennessee

The Tennessee Higher Education Commission (THEC) provides oversight for two governing systems in the State of Tennessee: the University of Tennessee system governed by a board of trustees and the Tennessee Board of Regents system with oversight for the state universities, community colleges, and technical colleges. There are 9 public universities, 13 two-year institutions, and 27 technology centers in Tennessee. No public institution within the State of Tennessee was ranked in the top 20 of institutions receiving federal R&D funds in 2009. Tennessee was one of two states selected during the first round of RTTT applications to receive \$500 million in federal funds to support school reform plans (State of Tennessee, 2011). THEC was a contributor in ensuring the success of the Race to the Top initiatives. As such, THEC has developed the "First to the Top" program, which includes specific STEM initiatives for higher

education within the state. THEC worked collaboratively with the Tennessee Department of Education and the Governor's Office in implementing the RTTT plan. In order to facilitate this work, THEC created a specific division with responsibility for implementing projects that directly relate to higher education (THEC, 2010).

Data Collection

Based on the comparative case study research design, I collected data from interviews with policy actors in each sample state and from relevant documents and archival materials. This section outlines the identification of informants, the interview protocol, and the collection of archival materials and documents. Yin (2009) recommends the following interview protocol in order to increase reliability: a data collection plan, expected preparation prior to site visits including how access will be gained to interviewees, and a procedure for protecting human subjects.

Identification of Informants/Interviewees

Yin (2009) describes how the use of an in-depth interview may lead the interviewee into providing other sources of information such as additional documents to examine or other interviewees. When an interviewee provides more than just responses to question, they may be considered an "informant" (p.107). This study identified informants in two ways. First, targeted informants were selected based on identification from the document analysis as actors most integral to the STEM innovation. I identified these individuals based on their formal position and through media coverage of the policy innovation. The different data sources used to identify these informants include: *The Tennessean* (TN), *The State* (SC), and *Atlanta Journal Constitution* (GA); the RTTT application, websites of government agencies, including higher

education governing boards, state legislatures, and offices of the governor; and, conversations with individuals familiar with the sample states.

Second, this study employed the snowball sampling technique whereby I asked the first interviewee to recommend others to interview, and so on. The initial informants were selected because of their central role in activities involving distribution of ARRA funds and in their role as a co-sponsor on the RTTT application. Initial informants were then relied upon to provide names of potential interviewees from the other groups related to STEM innovations.

Interview Participants

This study included interviewees from various sectors of state higher education, including staff of the statewide governing or coordinating board, related state agency staff, the governor's senior staff members, and other actors involved in state STEM initiatives. I based the selection of interviewees on whether the state higher education agency organizational structure has a specific office dedicated to STEM innovations and the extent to which the state higher education agency engages with other agencies in the application for and implementation of STEM-related initiatives funded through ARRA/RTTT. As such, state higher education agency staff members whose title indicates involvement in oversight for the implementation of STEM innovation or oversight for ARRA funding were identified as potential interviewees. If the state governance structure for higher education includes a central governing board consisting of appointed members who might have played a role in advancing a specific STEM initiative, I examined meeting minutes to identify chairs of subcommittees or individual actors to include as interview participants.

Within the executive branch of government, governors' offices that created a committee or separate office with oversight for the ARRA/RTTT grant were identified as key actors and

interviewed for the study. In Georgia, I conducted interviews with three members of the Governor's staff who represent various offices and, in Tennessee and South Carolina, I interviewed one member of the Governor's staff for each state (as illustrated in Table 2). In some states, collaboration across agencies occurred due to the nature of the STEM innovation. For example, in the state of Georgia, the RTTT application process involved participants from the Governor's Office, the Governor's Office of Student Achievement, the Georgia Department of Education, and four working groups (Georgia Office of Planning and Budget, 2011).

Tennessee's successful RTTT grant application was a joint effort between THEC, the Tennessee Department of Education, and the Governor's Office. As required by the RTTT application guidelines, South Carolina had the support of the Governor's Office and the Department of Education initially with the intention of involving additional partners, including the Commission on Higher Education, after receiving approval. Therefore, the selection of interviewees from other state agencies that played a role in the STEM innovation was necessary. In Georgia, interviews included a respondent at the higher education system office and an institutional administrator. Within South Carolina, I interviewed one state agency official and four current/former higher education system officials. Due to the coordinating structure in Tennessee (with a coordinating agency and two governing boards), I interviewed two staff members at the higher education coordinating agency, three staff members at the governing boards, and one institutional administrator. Table 2 summarizes informants by category in each sample state with the first number reflecting the actual number of interviews conducted and the second number reflecting the number of informants contacted initially for interviews.

Table 2. Distribution of Interview Participants and Identified Informants

	Georgia	South Carolina	Tennessee
Governor's Staff	2/4	1/2	1/1
State agency officials	1/6	1/5	0/3
Campus/System officials	2/3	3/7	7/11
TOTAL	5	5	8

Beamer (2002) discusses the importance of conducting “elite interviews” as a core component to completing research on state politics. Elite interviews target people who have special insight into specific policies and political issues. An inherent challenge of interviewing elite subjects is the power differential that might exist between a graduate student and an elite subject. Elite subjects might experience research fatigue if they are frequently approached for interviews because of the position they hold or they may not feel they have the time to participate in research efforts. As such, elites may be less likely to contribute to a study or not respond to interview requests. In this case study, there is evidence to suggest that the unequal response rate between campus and system officials choosing to participate and state agency staff or members of the governor’s staff may be due to the inherent difficulties in conducting research with elites. The result is a greater response rate from campus and system officials, which provides responses that may favor this perspective.

Interview Protocol

Rubin and Rubin (2005) support an interview protocol that starts with general questions and gradually grows in specificity. I asked informants questions that most directly relate to their area of expertise or in which they had direct involvement during the formation of the policy

innovation. By using a semi-structured interview design, I incorporated a standard protocol while also allowing for the adaptation of questions to the circumstances of a particular interviewee and to content that emerges in the course of the interview. Through the last question, I intended to bring a sense of finality to the interview and provide an opportunity for the respondent to share anything else that they felt was important, but that might not have been asked. A copy of the interview protocol can be found in Appendix C.

The average length of an interview was 60 minutes. Respondents selected the interview location, but most often occurred in person at their place of employment. While in-person interviews were preferred, I did conduct telephone interviews in order to accommodate the schedule of the respondents. All respondents were sent a waiver of consent outlining the purpose of the study and clarify the degree of confidentiality. Respondents were given the choice of confidentiality using pseudonyms, identification by their name, or identification only by position title.

Interview protocol focused on four main areas: (1) the political, economic, and social conditions in each state at the time the RTTT grant was made available; (2) the perceived problem that motivated the state higher education agency to innovate; (3) the external influences (national and regional) that shaped the STEM innovation; and (4) the internal influences (expectations, rules, standard practice) which shaped the STEM innovation proposal(s) that were included in the final grant application. I designed the initial questions to be broad in nature in order to encourage an open dialogue. Interviews were audio-recorded, with the respondents' permission, and transcribed fully. Furthermore, I took extensive field notes during on-site visits.

Archival Materials and Documents

Interviews are enriched with a review of various documents such as public agency documents, memos, reports, speeches, agency websites, and newspaper accounts to build an understanding of the innovation process. As Yin (2009) explains, the researcher can use documents to help “corroborate and augment evidence from other sources” (p.103). Therefore, archival documents should be part of the initial data collection plan as one way in which to identify informants and guide the development of interview protocol, as well as provide additional sources of evidence to support informant’s recollections.

This study relied heavily on archival documents in order to corroborate evidence shared by interviewees and to provide additional details of the policy process. I analyzed roughly 100 documents, including more than 14 newspaper articles, 34 state agency reports, 16 national policy organization reports, 17 agency websites, and all RTTT application materials submitted by the three states for this study. In Tennessee, core documents included the First to the Top Act of 2010, THEC’s Public Agenda for Higher Education, and Complete College Tennessee Act. In Georgia, I analyzed the Governor’s strategic goals and the USG Complete College Georgia and STEM Initiative core documents. For South Carolina, the South Carolina Commission on Higher Education Action Plan served as the core document for this study. Nationally, the U.S. Department of Education’s RTTT grant criteria and documents from Achieve and the Complete College America program served to provide the foundation on national influences influencing STEM innovations. As such, documents and archival materials served as a core data source for this study. Because of the interviews and document information obtained through this study, I was able to achieve saturation with the data (discussed further in the section on trustworthiness and validity).

Data Analysis

Yin (2009) describes the need for researchers to design an overall analytic strategy with the intention of putting together the case study “story.” Within this dissertation, data analysis relies both on deductive and inductive strategies. The analysis relies on two primary techniques: use of an analytic framework to examine how the data is supported by theoretical literature and the use of pattern matching to examine data within states for themes. In this dissertation, I examined state higher education policy innovations within STEM using diffusion models (both national interaction model and regional diffusion) and institutional theory to make analytic generalizations between cases.

Analytic Framework

In order to analyze the data systematically, I used an analytic framework to provide structure to the interview protocol and serves as the basis for coding themes during data analysis (found in Appendix D). Each of the dimensions aligned to a theoretical model by which the case studies were analyzed. Specifically, the three dimensions of the analytic framework examined how STEM policy comes to be on the state higher education agency agenda:

1. Role of national interaction. *What was the perceived problem that motivated the state higher education agency to innovate? Were there **national standards** that put pressure on states/ state higher education agency to conform? What interactions took place between state-level leaders through **national communication networks**? Which **organizations** are cited as facilitating these interactions (NGA, NCSL)? In what way did the **RTTT incentives** influence the STEM innovations pursued in the initial RTTT applications? How did RTTT applications change in subsequent phases and what influenced those changes?*

2. Role of regional diffusion. *Did states consider what their **neighbors** were doing related to ARRA/RTTT grants when deciding what direction to take with STEM innovations? Were there **interactions or meetings between state leaders** that may have influenced STEM innovations? Which state neighbors or innovations were examined as “successful” during the planning stages of the STEM innovation and which states or innovations were held up as a “lesson learned.” Do respondents cite the need to “keep up” or “**compete**” with other states in STEM innovations? Are there **ideological similarities** between states?*

3. Role of institutional theory to explain how certain innovations gain acceptance. *What were the **policies and practices already in place** that made particular STEM innovations rise to the state higher education agency agenda? What unspoken expectations lead to the adoption of a particular STEM innovation? Was there a sense that the organization should **conform to a standard or “acceptable”** way of doing something? Were there particular **organizational practices** that led leaders to consider some STEM innovations over others? Did members receive **feedback that reinforced** particular innovations? Did members within the organization provide input or prompt shifts in practice? Did administrative heads and members of the larger national or state network dictate implementation of STEM innovations? Are there ideological similarities between states that may have led to **isomorphic activity** around STEM innovations?*

Within-case and cross-case analysis

Within each sample state, analysis was conducted in four stages: (1) background context and history of the state and the higher education system; (2) narrative chronological account of the innovation process since the economic crisis of 2007; (3) case analysis of data from

interviews, documentation, and archival materials; and (4) involvement of the state higher education agency in STEM innovations. The coding system to categorize data included: (1) national standards, networks, or organizational pressures which influenced STEM innovations; (2) influence of RTTT incentives on STEM innovations; (3) regional influences including practices of neighboring states and ideological similarities; (4) interactions between state leaders within the region; (5) the perception of competition with neighboring states for resources; and (6) standardized rules, processes, or expectations that may indicate the role of institutionalized practice on what STEM innovations were further advanced in the RTTT application.

Comparative case studies are more robust than single case studies due to the ability to conduct cross-case analysis (Creswell, 2007). After an analysis of data within each state, a cross-case analysis examined similarities and differences between each case. Based on the maximum variation sampling technique, the cross-case analysis utilizes the analytic framework to identify patterns in STEM innovations due to inter-organizational, regional, or national influences.

Trustworthiness and Validity

Lincoln and Guba (1985) share five axioms that support naturalistic evaluations: (1) there is no single reality, but instead multiple realities that are socially constructed; (2) truth is time and context-bound; (3) action is explainable only in terms of interacting factors; (4) the relationship between researcher and respondent is one of respectful negotiation and learning; and (5) inquiry is value-bound. Rather than reliability, the researcher seeks to establish dependability that results will change due to situational contexts. Creswell (2009) views trustworthiness as the strategies employed to document “accuracy” of data and recommends at least two strategies in

any given study. As such, in order to establish trustworthiness in this study, I employed triangulation of data and thick descriptions.

In contrast to the naturalistic paradigm, Yin (2009) outlines four tests to establish quality in social research that mirror quantitative approaches to validation: reliability, construct validity, internal validity, and external validity. Reliability refers to the ability of the researcher to demonstrate how they operationalized the study so that future researchers can replicate the study and achieve the same results (Yin, 2009). In order to increase the reliability and construct validity of the case study, this dissertation maintained a “chain of evidence”; whereby, the derivation of evidence from the initial research questions to the case study conclusions is evident (Yin, p.122, 2009). By using thick descriptions, the researcher compiles a “complete, literal description of the incident being investigated” (Merriam, p. 11, 1988). Lincoln and Guba (1985) explain that thick descriptions allow for the interpretation of data in terms of cultural norms and values. Since case studies can provide thick descriptions, describing the context in which one action occurs and how this action leads to another, this technique allows for transferability. Thick descriptions provide a base of information that logically leads to the same judgment in other cases using detailed case narratives. In the data collection stage, I utilized a case study protocol, recording and transcribing interviews, collecting field notes, and documenting evidence in a case study database in order to address reliability.

Multiple sources of evidence including archival documents and interviews during the initial data collection phase also ensure construct validity. Since an informant’s recollections of events may include recall error, documents serve to triangulate data to ensure the accuracy of the cases developed (Lincoln & Guba, 1985; Yin, 2009). Findings from the interviews were triangulated with themes from the research literature and archival documents as a second test of

construct validity. Triangulation is the use of dissimilar methods to study the same unit so that the flaws of one unit of analysis are the strength of another (Merriam, 1988). By combining various analytic strategies, the strengths of each are employed at the same time and therefore overcome any deficiencies; thereby, adding strength to the reliability and internal validity of the study. The researcher assesses the validity of a piece of evidence by comparing it with the other evidence available at the same point in time (Lincoln & Guba, 1985). “The greater the convergence attained through the triangulation of multiple data sources, methods, investigators, or theories, the greater the confidence in the observed findings” (Erlandson, et. al, p. 139, 1993). The result of triangulation is the expansion of meaning due to the overlap of information from different vantage points. As Lincoln and Guba suggest, I addressed internal validity by comparing interview data with archival documents. Through the extensive use of archival documents, I was able to identify commonality in themes reported and verify similarity in perspectives about the timeline of events. Furthermore, the document analysis revealed that the interviews conducted represented all major agencies involved in the RTTT application development and that other agencies were much less central to the process. Through inductive and deductive analytic approaches, an analysis of interviews and archival documents revealed a convergence of data around the common themes described later in this study.

Internal validity is mainly a concern for explanatory case studies, so the test is not as significant for this study. Regardless, this study used pattern matching as an analytic tool, which Yin (2009) identifies as an additional way to address internal validity. A second way in which internal validity is achieved is through defining and testing rival explanations. Contrasting perspectives of participants may produce rival descriptive explanations that are grounded in the theoretical frameworks employed within this study.

External validity considers the generalizability beyond the immediate case study. To address this test, this study analyzes three cases and utilizes “theoretical replication logic” in selecting the sample states in order to generalize findings to broader theoretical frameworks (Yin, 2009).

Limitations

This study is limited in the generalizability of the findings due to a lower than expected response rate for interviewees. As described earlier in this chapter, challenges exist when attempting to interview elites. For example, several of the respondents identified in the document analysis, declined to be interviewed for the study or never responded to the researcher’s inquiries. In several instances, the identified informant who declined to be interviewed or who never responded worked in a senior level position with a state agency or served in a current political role. Of the informants still working in a political role, they cited they did not want to be associated with any “bad press” that might come from commenting on current work in (or lack thereof) STEM innovations within the state. Referrals made by interviewees in some states indicated that a handful of actors were involved in the RTTT grant application and the state had few individuals who could speak directly to STEM innovations that occurred during this period. As such, the interviews I conducted in those states were with the major policy actors and no additional names outside the small circle of participants initially identified were available. In other states, participants who declined to be interviewed or who did not respond to multiple inquiries were largely found in agencies viewed as tangential to the core work being done on STEM innovations (so they did not see the point in participating). Other prospective interviewees whom I identified were later discounted by the respondents as actors

who represented the same office, who were not instrumental, or who would be unable to provide additional information beyond what the initial respondent had already relayed.

I have attempted to minimize the possible impact of a lower than expected response rate for interviewees by utilizing newspaper articles to capture the outline of historical events that lead up to the RTTT grant application and I specifically searched for documents, such as state agency reports, briefs, press releases, and national policy reports, that would refer to key informants who were not interviewed or whose offices may have been involved. In spite of this limitation with sample size, the results of this study indicate saturation within the sample since referrals from informants cited similar names to those who the researcher interviewed previously. Furthermore, analysis of multiple data sources allowed for the triangulation of data, as Lincoln and Guba (1985) and Yin (2009) suggest. As mentioned earlier, I achieved triangulation by comparing comments by interviewees with documents, whereby similar summaries of the timeline of events and policy actors' actions were mutually reinforced. Additionally, respondents in each state gave similar perspectives on the major STEM innovations arising during this period and the influence of RTTT on the direction the state higher education governing agency took with STEM.

CHAPTER FOUR

TENNESSEE: SUCCESS BEGETS SUCCESS

Introduction

Prior to the 2007 economic recession, Tennessee had several ongoing initiatives to raise the success of K-12 students in STEM and to increase the number of students continuing in the STEM pipeline at the postsecondary level. The Bill and Melinda Gates Foundation tapped Tennessee as a “state showing promise” in K-12 education reform – providing additional resources to assist Tennessee in making a successful bid for Race to the Top (RTTT) funding. With RTTT funds in hand, Tennessee was able to move more quickly on the STEM initiatives in progress and use this advantage to leverage the state for additional STEM partnerships and external funding opportunities. Furthermore, the Battelle Memorial Institute (Battelle), which had a long-standing partnership with the University of Tennessee at Knoxville (UTK) in managing the Oak Ridge National Laboratory (ORNL), provided a research infrastructure that opened the state to additional STEM innovations - particularly in the field of alternative energy. As Governor Phil Bredesen entered his final term in office, the compounding effect of the state’s recent success in securing STEM partnerships and external financing for K-12 reform positioned the administration to capitalize on these accomplishments and bring attention to another top priority – reforming the state’s higher education system. The Tennessee case illustrates the role of professional networks in the advancement of STEM initiatives; the continuing independence of research universities in STEM innovations; and how the availability of private funding

sources can shift a state's focus toward an emerging national agenda – in this case, college completion and the Complete College America program.

This chapter comprises three sections. The first section summarizes the governmental and educational structures in Tennessee. The second section outlines a narrative chronology, first by reviewing the events already in play prior to the 2007 recession, then highlighting seminal events or actors of the STEM innovations that were included in the RTTT application, and concludes with statewide STEM initiatives occurring outside of the RTTT efforts. This section relies heavily on interview data, presented in large segments at times, and archival documents for background and corroboration of interview data. The final section presents an analysis of the Tennessee case by utilizing the six dimensions of the analytic framework drawn from two diffusion theories and institutional theory.

Overview of State Context

Governmental Structure

In this section, I describe briefly the governmental structure in Tennessee, which includes a description of the executive and legislative branches, their leaders, and composition of the membership of the general assembly. A description of the formal powers and characteristics of the executive and legislative branches provides context for a greater understanding of the environmental influences that may play a role in the state's actions around STEM innovations arising during a period of economic recession.

Tennessee has a longstanding tradition of re-electing incumbent governors. In 1978, Tennessee enacted a constitutional change that allows governors to serve two consecutive four-year terms. Phil Bredesen was the fourth consecutive governor to serve two consecutive terms, sitting as the Governor for the state of Tennessee from January 2003 until January 2011. When elected, Bredesen was the first Democrat to win a statewide election in Tennessee since 1990.

Governor Bredesen was succeeded by Bill Haslam, a Republican, in January 2011. Haslam continued Bredesen's education reform initiatives due to the state's successful bid for Race to the Top funds. In an effort to define his own education agenda, however, Governor Haslam hosted a series of roundtable discussions with business leaders around the state to identify how higher education can meet the needs of the workplace and the state's economy. Thus, the emerging education agenda for Tennessee since 2011 has become one of raising educational attainment levels of the state's citizens and increasing degree completion rates at postsecondary institutions.

The governor appoints 22 cabinet-level officials in addition to lay members of 12 statewide boards and commissions, including three statewide higher education boards. With regard to statutory power, Tennessee's governor ranks sixth, by scoring above average on all categories except "budget power" (Beyle, 2004). The governor's institutional power is the highest among the three states in this study with a 7.6 score on a 10-point scale (Beyle & Ferguson, 2007). In 2007, the governor's personal power was a 3.8 on a 5-point scale (Beyle & Ferguson, 2007). The size of the governor's legislative staff compared to the congressional staff is less than the other two states in this study (Squire & Hamm, 2005).

Tennessee's General Assembly also has the longstanding tradition of having little turnover in representation. According to Squire and Hamm (2005), for every state senator, Tennessee has three house members. Members in the House serve two-year terms and members of the senate serve four-year terms. As noted by Squires (2007), legislative professionalism is one measurement of the level of pay, staffing, and time demands required of state legislators. Researchers use this measurement to identify additional internal determinants that may affect the policymaking process. Tennessee ranks 38th in terms of legislative professionalization, which is

below the median of all states (Squire, 2007). Each House and Senate members has year-round personal staff at both the capitol and in their district, as well as professional and clerical staff support. In 2007, Tennessee had 17 Republican Senators and 16 Democratic Senators (CSG, 2007). At the same time, there were 46 Republicans and 53 Democrats in the House. At the time of the RTTT grant application, there had been a shift in favor of Republicans in both houses (19 in the Senate and 50 in the House) (CSG, 2009). After the 2011 election, the Senate added a Republican and the House Republicans numbered 64 (CSG, 2011).

Higher education structure

The legislature created the Tennessee Higher Education Commission (THEC) in 1967 to serve as the statutory coordinating agency for higher education institutions in the state. THEC consists of nine member representatives, appointed by the Governor, who serve nine-year terms. The Executive Director of the State Board of Education serves as an ex-officio member and the members appoint the executive officer of THEC. THEC is charged with planning and coordinating public technology centers, community colleges, and public colleges and universities. The board reviews institutional budgets, approves new program requests and makes recommendations to the legislature on higher education policy issues. Dr. Richard Rhoda has held the position as THEC's executive director since 1997 (TBR, 2012).

There are two institutional governing boards in the state of Tennessee: The Tennessee Board of Regents (TBR) and the University of Tennessee System (UT). TBR provides oversight for 6 colleges/universities, 13 community colleges, and 27 technology centers. The Board of Regents is comprised of 19 members. John Morgan assumed the Chancellor position at the Tennessee Board of Regents in 2010 after serving as the Deputy to the Governor and education policy advisor for Governor Phil Bredesen from 2009-2010. He previously served 10 years in

the position of Comptroller for the Treasury (TBR, 2012), which serves on over 34 boards and commissions, including the Tennessee Higher Education Commission and Tennessee State School Bond Authority.

The University of Tennessee System (UT) has a board of 24 trustees (which includes the Governor as Chair) and gives oversight to four campuses as well as the extension and public service units (UT, 2012). Since 2001, five presidents have held the UT presidency including Dr. John Petersen from 2004-2010 and Dr. Jan Simek from 2009-2010. Currently, the University of Tennessee President is Dr. Joe DiPietro, who took office in 2011 after serving as chancellor of the UT Institute of Agriculture from 2006 to 2010 (UT, 2012).

Among public universities, the University of Tennessee, Knoxville (UTK) is considered the state's flagship research university. During fiscal year 2010, UTK ranked 71st in the nation in terms of federal spending for university research and development (CHE, 2012). This ranking reflects the institution's middle of the road status among public research universities in the three states included in this study, with Georgia Institute of Technology ranked 25th and the University of South Carolina and University of Georgia ranked 89th and 97th, respectively. UTK has a longstanding partnership with Battelle, a charitable trust headquartered in Columbus, Ohio that manages several national laboratories for the U.S. Department of Energy and the U.S. Department of Homeland Security. One of those laboratories is the Oak Ridge National Laboratory located in Oak Ridge, Tennessee, which both Battelle and UTK operate. The Oak Ridge National Laboratory's primary focus is to conduct research in energy and global security.

Unlike some states that have integrated technical and occupational education into community colleges, Tennessee has maintained an operational distinction between technical and occupational education, represented in the Technology Centers, and its two-year community

colleges. Technology Centers are governed by the Tennessee Board of Regents, but provide workforce delivery diploma programs—they are not degree based. As evidenced by the recent attention of the Gates Foundation, Tennessee Technology Centers have garnered national attention for their high completion rates and their ability to place graduates into technological jobs. The community colleges, on the other hand, emphasize not only associate degree programs, but transfer articulation of course work with the four-year institutions in the state. Thus, the state structurally positioned community colleges to be entry points for underprepared or financially constrained students for the postsecondary pipeline. Later, the college completion agenda laid out by Tennessee in its Complete College Tennessee Act of 2010 would further reinforce this structure.

Tennessee's Independent Colleges and Universities Association (TICUA) is a membership organization for the private institutions within Tennessee. Created in 1956, the association works on behalf of 34 member colleges and universities on public policy issues and is a member of the larger National Association of Independent Colleges and Universities (NAICU) and Council for Independent Colleges (CIC). The most research-intensive member institution within TICUA is Vanderbilt University located in Nashville, Tennessee. In the most recent *Chronicle of Higher Education Almanac* (2012), Vanderbilt ranked 23rd in university research and development spending financed by the federal government for fiscal year 2010. This is the highest ranked institution from within the three states included in this study. Vanderbilt is a major collaborator with the UT System and TBR on STEM-related initiatives. For example, UT and TBR collaborated with Vanderbilt to create the Experimental Program to Stimulate Research (EPSCoR) Tennessee Solar Conversion and storage using Outreach, Research, and Education (TN-SCORE) project, funded by the National Science Foundation.

Vanderbilt's involvement in state-level STEM initiatives will be discussed more fully later in this chapter.

Narrative History of Events and Policy Actors

This section provides a narrative chronology of how STEM innovations came to be on the state governing board's agenda. State education officials were working on several initiatives prior to the economic recession and a network of policy actors connected to national non-profit education organizations influenced not only the direction taken with STEM innovations, but also the funding opportunities made available to Tennessee. All of these factors led to the eventual development of legislation that institutionalized specific STEM innovations. Before describing the seminal events and actors, this section first provides the background of what was occurring in Tennessee prior to Race to the Top grant application.

Antecedents to the Race to the Top Grant

Before 2007, there were several ongoing statewide initiatives with the goal of positioning higher education institutions to become more competitive to receive federal funding for research. A primary example is the EPSCoR program, which Tennessee joined for the first time in 2003. The EPSCoR initiative is a federal-state partnership that funds research and development activities in states that have traditionally not received high levels of federal funding. With EPSCoR membership, Tennessee is eligible for Department of Education (DOE), National Aeronautical Space Administration (NASA), and National Science Foundation (NSF) funding to improve the research infrastructure in the state. In 2005, NSF funding to Tennessee increased to the point where the state no longer met eligibility criteria, but the state maintained its funding connections for three years. In 2007, however, funding levels dropped to a level where the state again became eligible for EPSCoR funding – which would lead to STEM innovations tied to

state objectives in the alternative energy field. As will be described later, the availability of federal funding to match state investment in alternative energy research would allow the state to leverage its research partnerships to attract additional alternative energy industries to the state.

Furthermore, there were several network connections between policy actors in Tennessee and national non-profit educational organizations already at work in Tennessee before the RTTT grant application. Education leaders incorporated many of these initiatives into the RTTT grant so that the state could gain additional financial resources to expedite the work already in progress. The first major initiative that influenced STEM education reform in Tennessee was the Tennessee Diploma Project. The goal of the Diploma Project is to raise educational standards and curriculum to better prepare high school graduates for postsecondary education. Managed by the national non-profit organization, Achieve, the Diploma Project is a network of states that are aligning high school standards and graduation requirements to meet college and career requirements. Tennessee launched its Diploma Project initiative in 2007. Tennessee's work with Achieve on the Diploma Project resulted in the 2008 adoption of the Tennessee Ready Core (which raises high school graduation requirements to align with TBR admission criteria), the 2009 adoption of academic standards (which aligned with college and career-ready expectations), and the 2010 adoption of the Common Core State Standards (Achieve, 2011). Tennessee most recently became a member of the Next Generation Science Standards initiative, which Achieve began spearheading in 2011.

Respondents shared how there were also institutional efforts in STEM innovations prior to the RTTT grant application that sought to make connections with state industry. In 2005, the TBR approved Middle Tennessee State University to provide Professional Science Master's (PSM) degrees for the first time. A PSM is a graduate degree developed with industry to provide

advance training that consists of two years of course work in an emerging or interdisciplinary area combined with an internship or hands-on training in a focus area (PSM, 2012). One higher education official described how the PSM degree is similar to a MBA because in the first year students do coursework, but the second year also includes an internship in an industry.

The PSM program, which started in 1997 with funding from the Alfred P. Sloan Foundation, was extended in 2001 through a grant to the Council of Graduate Schools and in 2006, the Council of Graduate Schools assumed primary responsibility for supporting and expanding the initiative with the goal of institutionalizing the program within graduate education programs nationally (PSM, 2012). While there are 270 PSM programs offered nationally, these programs are concentrated at only 91 research universities; the majority are at institutions that are not considered the flagship institutions within the state. In Tennessee, Middle Tennessee State University is the only institution offering PSM programs. The degrees offered include actuarial science, biostatistics, biotechnology, engineering management, geosciences, and health care informatics (PSM, 2012).

Role of Professional Networks in Guiding STEM Innovations

Professional networks were integral to the development of STEM innovations within Tennessee. One of the most influential organizations was Achieve. Achieve is an independent, bipartisan, nonprofit education reform organization founded in 1996 by a group of U.S. governors and business leaders. Achieve's primary goal centers on increasing academic standards and assessments which resulted in the organization's release of its Common Core State Standards in 2010 (Achieve, 2012). Achieve's influence in guiding STEM innovations in Tennessee was made possible through a network of supporters among non-profit education organizations. While Battelle already had a long-standing relationship with Tennessee through

management of the Oak Ridge Laboratory, Battelle was involved in Achieve's Common Core Standards Initiative and played a foundational role in developing standards for the federal Race to the Top grant. In addition to connections with Battelle, Achieve has among its supporters several other national non-profit organizations including the Bill and Melinda Gates Foundation, Carnegie Corporation of New York, and Lumina Foundation (Battelle, 2012).

Involvement with Achieve, in combination with the state's partnership with the Education Trust, opened up additional opportunities for the state once it received RTTT funds. Through Tennessee's association with Education Trust, the state became part of a subset of public higher education systems that participate in the "Access to Success Initiative." In August 2010, the Education Trust launched the U.S. Education Delivery Institute, which assists institutions in mobilizing their college completion efforts. One higher education official described the flow of how involvement in one initiative led to another:

In 2007, we probably signed up for the Diploma Project and became affiliated with Achieve. Later our Governor would go on the Board of Achieve, and maybe actually served as chairman - Bredesen did. Because of that affiliation, and because of Race to the Top and the creation of Delivery Unit, which is essentially abandoned, by the way, in K-12...but because of those connections, we were invited to be part of the Education Delivery Institute, which is kind of a joint project between Achieve and the Education Trust. And we are very much a part of that, which puts us in a network of states that are part of the Education Delivery Institute—some systems, some institutions, but we're in it as a system. That's giving us a valuable opportunity to network with other states.

A network of policy leaders in Tennessee also influenced funding opportunities and garnered additional experts to assist with the drafting of the RTTT grant application. Again, many of the actors connect to the work that Achieve undertook within the state. Governor Bill Haslam currently serves on the Board of Directors for Achieve as does the Battelle Foundation President and CEO, Jeff Wadsworth. As the respondent noted above, Bredesen formerly served on the Board of Directors for Achieve when he was Governor of Tennessee. The Vice President

for State Leadership and Policy Development at Achieve is Margaret Horn, who previously served as the chief education policy advisor to Governor Bredesen from 2008 to 2010.

The specific policy leaders working within Tennessee primarily connected through the Achieve organization. For example, through connections with Achieve, a shared network of policy actors existed between Tennessee and Battelle. The state received consulting assistance from Complete College America, Education First, and Gates Foundation that connected to Achieve through Susan Bodary. Thus, prior to the RTTT grant application, the state had network connections with the various non-profit education reform agencies by virtue of having current and former state employees who also worked with these same non-profits.

The state capitalized on these network connections when Tennessee made the decision to select Education First to assist state leaders in writing the RTTT grant. Education First is an education consulting firm that specializes in four areas: college and career readiness, college completion, teacher and leader effectiveness, and STEM strategies (Education First, 2012). As a partner with Education First, Susan Bodary led the work of writing the RTTT grant for Tennessee. Part of this work was to negotiate the partnerships for the Tennessee STEM Innovation Network (STIN) on behalf of the Governor's office. She had experience working for several national education organizations including Achieve, Bill and Melinda Gates Foundation, and Complete College America. Education First also has connections with Battelle – working on the development and management of relationships for the Battelle Multi-State STEM Network. The Network is an emerging group of states working together to advance STEM teaching and learning with the goal of fostering STEM talent within participating states (Education First, 2012). Furthermore, Education First worked with Achieve in the development of the organization's strategic plan. Bodary's multiple roles and the overlapping influence of previous

experiences with Battelle in both Ohio and Tennessee signify the importance of professional networks in advancing particular STEM innovations.

While several efforts were in progress for K-12 STEM education reform that would have an impact on teacher preparation programs and standards for entering college students, higher education reform had yet to become a major agenda item for the Governor's Office before the RTTT grant was announced. This focus changed, however, as Governor Bredesen worked within professional networks and gained access to additional resources. One higher education official describes the evolution of the higher education agenda:

... he decided to really take on the issue of higher education and thinking about higher education in Tennessee. For the first six years of his service as Governor, he had kind of ... he had focused very much on K-12, and the Diploma Project and then the serious work that he did to build on what the state had been doing for several years in trying to move its K-12 system forward. But a lot of his time got absorbed in our Medicaid program, what we call TennCare. Dollars got absorbed there, energy got absorbed there trying to come to grips with what are we going to do about an unsustainable trajectory of our healthcare program. And because of his background in healthcare industry, he was . . . truly was probably the right person at the right time to deal with that issue. But that absorbed an awful lot of his political capital as well as his personal time and attention. So, higher education kind of got short shrift. I mean, he believes very much that it was important, but he just couldn't get there. So, in the last two years he decided he was going to look at higher education. And, in all honesty, that look at higher education—the subtitle of that would be organization of higher education in the state was in his mind. When he thought about we got to do something about higher education, I believe it's fair to say that he really viewed the big issue as being whether or not we were organized correctly where we have two systems, a coordinating board.

As the Bredesen administration began to focus on restructuring the higher education governance structure, the Obama administration announced the RTTT grant application. Thus, higher education structural reforms would have to wait as the administration aligned its ongoing education reform initiatives to leverage the state to compete for ARRA funding provided through the RTTT competition.

Rise of the Race to the Top Grant Application

Before the Department of Education selected Tennessee to receive RTTT funding, the Gates Foundation tapped Tennessee as a state showing promise in K-12 reform and committed to helping Tennessee advance its education goals. In fact, one respondent explained, when Bill Gates came to Nashville to explore how the Gates Foundation could support education reform in the state, he chose to visit a technical center because of the state's success in achieving high graduation rates through its technology centers. As a result, state leaders found themselves in an enviable position of having the leadership opportunity to shape the state's RTTT initiative so it could also provide funding to make their ideas for higher education reform a reality. With the help of the Gates Foundation, Tennessee was able to hire technical support from Education First and Susan Bodary. One respondent described the support:

Having Education First in the role of facilitating the development of our application and all the things that needed to happen in order for the state to be able to put its best foot forward was immensely beneficial. So, having someone from outside that, you know, as an expert, but really tasked with focusing the discussion, getting people on track, forcing people to be accountable for whether or not they completed assignments that they had from the last meeting, really created a framework within which good work could be done in a fairly short time frame, and we really didn't have much time.

One of the competitive advantage areas in the RTTT application was STEM. As one higher education official described the direction the state took with STEM and why:

STEM was kind of an enhancement opportunity for the Race to the Top application. It seemed like it was a . . . like an extra credit piece that if you addressed STEM. So, in our thinking and working with Education First . . . and one of the benefits of having Susan Bodary as part of our team from Education First is that she had a history with Battelle in Ohio when she worked for the Governor of Ohio, but Ohio was several years earlier and had been in different kinds of roles working with Battelle. So, as we began to think about, you know, what would a really dynamite kind of STEM initiative look like, we were able to craft something around the hope that Battelle and the state could enter into a partnership.

Another higher education official described the decision to select the STEM innovations that it did for the RTTT application as a natural conclusion for the state – there were already STEM innovations in progress, so all the state needed to do was get external help to assist the state in reaching its goals. As one higher education official explained:

We'd already kind of paved that road on all of these, especially where STEM was concerned. Like, we all knew that there was an imperative with STEM. The Governor had already made the announcement for our partnership with Battelle Memorial Institute. They'd committed a million dollars of in-kind costs. So, all of that kind of had already been placed. They'd already . . . he had already actually created the STEM Advisory Council prior to the application.

Before the Department of Education awarded RTTT funds in the first round, Governor Bredesen announced a partnership with Battelle to work with the state Department of Education and local school systems to develop a statewide network of programs with the goal of promoting and expanding STEM education – referred to as the Tennessee STEM Innovation Network (TSIN). Launched in 2011, Battelle now manages TSIN. The TSIN is modeled in part on previous STEM efforts led by Battelle in other states, including its home state of Ohio. The partnership came on the heels of President Obama's November 2009 launch of "Educate to Innovate," a nationwide campaign to move American high school students from the middle to the top in international rankings in science and math achievement over the next decade. Battelle is a "core partner" in the national campaign. The ultimate scope of the network hinged, in part, on whether Tennessee was successful in its bid to secure federal funds as part of the RTTT competition (State of TN, 2009). Initiatives administered by TSIN include regional STEM innovation hubs, STEM platform schools, and a virtual platform school/hub throughout the state (TSIN, 2012).

The incorporation of STEM academies and STEM hubs into the RTTT grant application is one example of how the state leveraged its current STEM innovations into the RTTT grant.

The programs mirrored national STEM initiatives for K-12 education – the most successful national program included was UTeach. UTeach, which began at the University of Texas at Austin in 1997, is a program that prepares college students to become secondary science, math, and computer science teachers. Over 33 universities nationally have replicated the program since this time. In Tennessee, there are four institutions implementing UTeach: Middle Tennessee State University, University of Memphis, UT - Chattanooga, and UT Knoxville. One respondent made an important distinction, however, between how Tennessee implemented UTeach compared to other states:

We have more UTeach sites than any state other than Texas, and Texas is the birth of UTeach ‘cause it’s you know University of Texas—UT invented it. We have four sites. No one else is all in the way we are on that. The other thing is no one else manages their sites centrally, and that’s a very . . . when we think about governance, I think that’s a very key point. So, right now, Georgia has a couple of UTeach sites. They don’t talk to each other. They’re institutional initiatives.

So, while Tennessee replicated the UTeach program through its RTTT grant, the state’s unique approach was to centralize control through THEC. Thus, THEC controls all funding and administration for the program.

RTTT and the State Higher Education Agency. The role that the state’s higher education governing boards played in the RTTT grant application was limited. Ultimately, THEC leadership largely drove the initiatives that tied higher education to the RTTT grant. As one higher education official pointed out, TBR already had a Ready to Teach program that is similar to the UTeach program, but it was not included in the grant application. The official speculated that this oversight was largely because TBR was not at the table for the discussion. While the Governor announced a STEM Advisory Board (which has TBR and UT representation) prior to RTTT funding, none of the respondents mention that the governing boards took an active role in

deciding on STEM innovations included in the RTTT application. Since the Department of Education explained that RTTT was a K-12 initiative, this comes as no surprise. What is surprising, however, is that RTTT criteria clearly outline that applications had to include connections with higher education and industry – particularly in the area of STEM. The application does lay out partnerships, but none of the respondents cited that the governing boards played a significant role in identifying these partnerships for the application.

At the governing board level, respondents cite how TBR sponsors a research academy and provides grant money for STEM research, but does not systematically drive STEM innovations statewide. Over half the people who are in the academy are STEM faculty in their first three years at their institution. The purpose of the academy is to help faculty conceptualize their research from the initial phases all the way through application and development. Respondents confirmed that TBR and UT representatives sit on the STEM Advisory Council. As part of their work with TSIN, Battelle works closely with this STEM Advisory Council in the execution of grants and contracts to build more STEM assets in the state.

The UT system also leaves STEM innovations to its individual campuses and faculty, but UT has benefited from targeted attention in STEM due to an unspoken expectation that it take the lead on all STEM related research for the state. Respondents cite how the legislature tends to be supportive of UTK and that Governor Bredesen was the biggest supporter of everything related to STEM going to UTK. The impact of this unspoken expectation means smaller institutions compete for research dollars with UTK. Since THEC and TBR policies restrict duplication of programs, smaller institutions must look for niches in order to try to win funding. Contrary to the funding and innovations created within the K-12 area of STEM during this time, stimulus funding did little to increase STEM innovations on an institutional level at

postsecondary institutions. As one UT research officer reported, the ARRA funds created a two-year bump that was not sustained by federal programs thereafter. As such, institutions have adjusted their funding levels back to original levels.

RTTT and Higher Education Institutions. Since Race to the Top largely dealt with K-12 education reform, the impact on STEM innovations outside of teacher preparation and student standards in STEM had little impact on institutional efforts in STEM. As such, the state continued to make strides in securing federal funds for STEM research and economic development funded by the ARRA. In 2010, the TN-SCORE initiative received NSF EPSCoR funding to develop research collaboration and STEM education around sustainable energy research between higher education institutions (public and private) in Tennessee (TSLA, 2012; UT, 2010). The role of private institutions in the collaboration is significant. As one respondent reveals, “Vanderbilt is one of the primary lead institutions (in the) Tennessee SCORE program.”

The higher education leaders wrote the TN-SCORE proposal to mirror the focus of Tennessee’s Innovation Road Map, which outlines the state’s innovation agenda. Written in 2006 by New Economy Strategies, LLC and funded by the Tennessee Technology Development Corporation, the Tennessee Innovation Road Map identifies collaborative opportunities for the state to increase its technology-based economic development (NES, 2006).

One respondent described the various state players involved in the creation of TN-SCORE:

We worked with identifying faculty across all of our institutions to—that were interested in anything related to solar energy, alternative energy—those kinds of things—that were varying levels of research activity in terms of publication and grants, and we collaborated with UT-Knoxville and with Vanderbilt and with Tennessee Technology Development Corporation, which is a group that the Governor commissioned to help with innovation and building business within Tennessee—bringing businesses in and such. And so, we collaborated to put together a grant, which at this point involves publics, private universities—13 institutions actually are involved now across the state. And there’s

about 51 of the researchers across the state that have interest in either development solutions, application storage, applications...and it's got a heavy outreach component...you see university faculty are going into K-12 institutions and teaching them about STEM in a very interactive fashion too...and they've set up internships for students—undergraduate and graduate—hired in new faculty.

The \$24 million NSF grant creates collaboration between these select institutions and four industries including Hemlock Semiconductor and the Tennessee Valley Authority – resulting in the creation of new academic programs and institutional facilities. As one education official described how Hemlock asked for the creation of an associate's degree at Austin Peay State University in Clarksville, Tennessee:

And they came to the legislature—THEC did—and said, 'Hey, just so you know, we're going to need to do this very quickly. We need an associate's degree right now, like at the next THEC meeting in chemical engineering technology. Also, there's no community college nearby, so we need to award an associate's degree at a four-year school,' which is completely unorthodox as you know. And we did it. And so, I guess one of the themes I've drawn from STEM involvement in higher ed is that once the economic things are pushing it, crazy things happen like starting an associate's degree in, like, 30 days. Externally funded, mind you, by Hemlock, but yeah, it's . . . our economic drivers are here now, but they weren't for a while, and I think that's a big part of our STEM story.

Therefore, the STEM innovations arising from partnerships with industry guided actions taken by THEC. The origination of these innovations, however, came from the partnerships made possible through ARRA funding directed by the NSF to specific institutions.

Building on the success of the TN-SCORE program, the Volunteer State Solar Initiative is a \$62.5 million dollar ARRA funded project through the U.S. Department of Energy that partnered the ORNL, Tennessee Valley Authority, and UTK to create two new initiatives. The first initiative is the Tennessee Solar Institute (whose purpose is to conduct solar energy research and product development) and the second is the West Tennessee Solar Farm (which produces solar energy for educational and demonstration purposes). With oversight from the UT Research foundation, higher education and government leaders viewed the project as a way to attract solar-

industry manufacturers to Tennessee. Furthermore, it reinforced partnerships between higher education institutions and industries like Hemlock.

A New Focus: First to the Top and the Complete College Tennessee Act

In mid-summer of 2009, representatives from the Gates Foundation flew to Nashville to check on the progress with the RTTT application. During the visit, Governor Bredesen mentioned the work that the state was doing to make its community college system more robust. As a result, the Gates Foundation decided it also wanted to help Tennessee with its higher education initiatives. Gates provided additional technical resources to help shape the higher education reform focus, particularly around college completion. Stan Jones, who was starting up the organization Complete College America at that time, Dennis Jones, and Aims McGuiness from NCHEMS were brought in to frame the discussion that shifted Governor Bredesen's focus from restructuring the higher education governance system to one of defining the public agenda for higher education. The main question they identified that needed a response was, "What does higher education need to promote the public agenda?" State leaders concluded that the focus should be "to raise education attainment levels in Tennessee."

Complete College America is a national nonprofit organization established in 2009 with the goal of increasing college completion and closing attainment gaps for minority populations (Complete College America, 2012). Some of the policy and research partners working with the Complete College America program include Achieve, Southern Regional Education Board (SREB), and State Higher Education Executive Officers (SHEEO) (Complete College America, 2012; SREB 2010). Five of the nation's leading foundations joined in support of Complete College America's efforts: Carnegie Corporation of New York, Ford Foundation, Bill & Melinda Gates Foundation, W.K. Kellogg Foundation, and Lumina Foundation for Education.

With an awareness of the emerging Complete College America program and with RTTT funding in hand, Tennessee officials took early steps to pass the First to the Top Act of 2010 in support of linking the current K-12 reform to higher education's completion agenda. The centerpiece of the Complete College Tennessee Act utilized the strategy of expanding and creating courses through the community colleges that promote consistency across the two-year system. This strategy allowed for statewide transfer of credits to a four-year university. It also required TBR and UT to establish dual-admission and dual-enrollment policies at all two- and four-year colleges and universities.

One higher education official pointed out that while most reform efforts acknowledge that K-12 and higher education are linked, it becomes difficult to actually make the pipeline seamless since the involved parties become focused on their own work; that is why Tennessee's approach was unique. As a higher education official emphasized, "Well, Race to the Top and Complete College . . . while it's a long way from causing that integration to occur that needs to occur, it was a major step forward in thinking about how the two relate."

Several respondents acknowledge, however, that Race to the Top was the primary catalyst to creating the First to the Top legislation. The First to the Top Act of 2010 outlines expectations for schools to meet performance standards, addresses teacher performance evaluations, and how RTTT funds will be administered to schools. As one higher education official explained:

If the money hadn't been out there, we wouldn't have been able to pass the bill. And over time, the same things might have been able to occur, but it wouldn't have happened . . . it wouldn't have happened quickly. Race to the Top—the \$4 billion—was the thing that caused people to say, 'Yeah, let's just do it,' which gave the Governor then an opportunity to also move on the higher education agenda in a special session. The first week was on Race to the Top; second week was on Complete College. That, in both cases, really made substantial changes in the environment . . . in the education environment in Tennessee that we hope leads to the success that we think it will through

Race to the Top.

The special session was a key process that focused policymakers' attention on educational policy issues, including STEM initiatives, in order for the state to advance its position as a national leader in education reform. Once the First to the Top legislation passed, Tennessee moved to become the first state to support the Complete College America initiative by enacting the Complete College Tennessee Act. As one higher education official concluded:

Well, the connection's then between Race to the Top and then what we also adopted in the same special session—the Complete College Tennessee Act—became a conversation that really did create a continuum of policy thought.

Governor Bredesen was instrumental in working with the state legislature in passing the Complete College Tennessee Act, which includes several sections that specifically address STEM-related initiatives for the state, including charging THEC with responsibility to develop a statewide master plan with input from the Board of Regents and the UT Board of Regents. While the overall focus of the master plan is to increase the educational attainment levels in the state through increased degree production, the legislature charged THEC with considering the state's economic, research, and workforce development needs and to differentiate institutional missions to reduce redundancy and minimize competitive research (T.C.A. § 49-7-202).

The Act also specifically speaks to the role of the University of Tennessee in expanding research initiatives with alternative energy and leveraging its relationship with the Oak Ridge National Laboratory for additional research funding (T.C.A. § 49-9-1501). Furthermore, the legislation expands the pipeline for STEM students in postsecondary education and in research activities. Specifically, the legislation outlines the need to increase the number of STEM doctoral students, the development of interdisciplinary programs in energy science and energy research at UTK and with other statewide faculty, and increase the number of STEM doctoral

students working on research at the Oak Ridge National Laboratory (T.C.A. § 49-9-1501 (pp. 1, 6, 7, 9)).

Finally, the legislation provides for the authorization for UTK to develop a partnership in educational programs and research with the Oak Ridge National Laboratory as well as describes the development of the Memphis Research Consortium (T.C.A. § 49-9-1502). The University of Memphis, University of Tennessee Center for the Health Sciences and St. Jude Children's Research Hospital are listed as lead collaborators (T.C.A. § 49-8-1401). The Complete College Tennessee Act, which specifically mentions the role of two research universities, but leaves others out, is another example of how the legislation institutionalized specific STEM innovations and who would take the lead in these innovations. As one higher education official explained:

And one example [of how UTK is favored] would [be] in the drafting of the Complete College Tennessee Act. Its original draft identified UT as the only research place in the state, and through the one week that (we were) involved and before the bill was passed, Memphis . . . TBR was able to work to get Memphis added. So, now there are two research institutions identified—Memphis in the health sciences and UT-Knoxville—but . . . I mean, that's in law. And that was written and driven by legislators with very little impact directly from either UT or TBR System.

As part of the Complete College Tennessee Act (CCTA) the legislature approved a new funding formula for higher education based on an outcomes model proposed by THEC. THEC tied the outcomes based funding formula to the CCTA in order to create a policy lever for postsecondary institutions to meet the goals outlined in the CCTA. The formula produces a value that is then translated into an appropriations amount awarded to each institution. Comprised of weighted measures, the formula takes into account the specific missions of the institutions and how well institutions do in student progression, degree production, efficiency, and other fixed costs (THEC, 2012). The design of the program is described by one higher education official this way:

The other things I'd say that we've adopted for policy levers in regards to STEM in higher ed. First, we have performance funding in the state. It absolutely needs to not get confused with outcomes-based funding. They're two different things. . .Both of those have STEM embedded within them though. So, PF—our quality assurance program—is 5.45 percent of each institution's funding. Our outcomes-based funding is the general appropriation to a school. So, within performance funding, one of the variables they can select is STEM as a student sub-population. It is Standard Two of performance funding...we're going to focus on five student groups that they select. . .who the five groups are. And then they are going to be measured on how those students are retained and graduated and enrolled as well. So, there's some recruitment there. STEM is one of those areas. . . that is the way our state is incentivizing STEM within higher ed. I believe it is unique. I'm not aware of another state doing that.

The outcome-based formula now drives 70-80% of state funding of public higher education. For research universities, THEC factors research and service activities into the funding formula (Chronicle, 2012; THEC, 2012). Additionally, all institutions can earn additional funding through “quality assurance” scores based on assessments of general education course, job placement rates, and student satisfaction studies. Under the new formula, THEC rewards institutions that show improvements on meeting benchmarks at a higher rate with greater appropriations than institutions that do not make progress.

The First to the Top legislation and the Complete College Tennessee Act illustrate how legislation institutionalized STEM innovations within Tennessee. Within the Complete College Tennessee Act, the legislature approved an outcomes based funding model that reinforces STEM initiatives that the state views as a priority. The funding model is another way in which STEM innovations gain support as “the way things are done.” The outcome data is weighted to reflect institutional mission, so research university funding is based on overall graduation rates, number of degrees conferred, and research; while regional comprehensive universities are rewarded for the number of baccalaureate degrees conferred and transfer students accepted for admission (Chronicle, 2012; THEC, 2012). As such, research activity accounts for 10% of funding at a masters degree granting institution, but 15% at a research-intensive institution (THEC, 2012).

Furthermore, throughout the legislation, the expectation that UTK continue to take the lead in STEM innovations for the state and that institutions engage in STEM research with the Oak Ridge Laboratory further illustrate how state leaders take for granted the role that UTK and ORNL play in STEM innovations within Tennessee – particularly with alternative energy research.

The Lasting Impact. Under Governor Haslam’s administration, the completion agenda took center stage and is viewed as integral to the state’s STEM initiatives. In a series of roundtable discussions with business leaders around the state, Governor Haslam learned that the number one concern of industry leaders is not STEM preparation of recent graduates, but the lack of STEM graduates to fill positions. A recent supply-demand study conducted by THEC and the Center for Business and Economic Research at the University of Tennessee also supported the need for producing more STEM graduates (CBER, 2011). Furthermore, *The Public Agenda for Tennessee Higher Education* (THEC, 2010) fully embeds the need to extend the STEM pipeline from K-12 into postsecondary education in order to meet industry demands. These findings give support for THEC’s work with other state agencies in developing a longitudinal data system (which was part of the RTTT grant application). As a result, the state is developing a plan of tracking students’ progression for education to career from the time they start school through postsecondary education with an emphasis on building student preparation for STEM-related careers.

Case Analysis

With the chronological narrative outlined, this section analyses the influences and events of the Tennessee case against the six dimensions of the analytic framework. (See appendix D for a summary chart of the framework.) The central question of this study is to examine how STEM

innovations come to be on the state higher education agency agenda. This study uses diffusion models to identify conditions that drive the spread of new policy ideas. As previously described, diffusion models explain how members of a particular professional or social system communicate about innovations through informal and formal channels over time (Berry & Berry, 2007).

Network Pressures That Influenced STEM Innovations

Tennessee's reform of its K-12 system, which aligned with national standards for curriculum and assessment in STEM, was in response federal requirements mandated through the RTTT grant criteria. Most respondents indicate that while federal funding helped to launch these initiatives, the initiatives themselves were in progress before funding became available. Tennessee lacked personnel and education experts who could focus on advancing the state's education reform agenda to take advantage of external funding opportunities. Once the state was able to secure technical assistance to write strong grant proposals and leverage relationships with other external agencies, a seamless education reform plan for the state materialized.

After the Gates Foundation began investing in Tennessee by providing this technical assistance, the network of experts from Achieve and the consulting group, Education First, were able to build upon the proven strategies for STEM education found in Texas (UTeach) and Ohio (The Ohio STEM Network). Connections between the various organizations meant that information was shared between policy leaders within a select group of member states. The national interaction model assumes that as the frequency of interactions among professionals and state officials within certain networks increases, the more likely those states are to adopt similar policies based on interactions with these members (Berry, 1994). Therefore, the conversation about education reform, which can be seen as a web of interrelated projects that all tied back to

the Race to the Top program, is evidence of diffusion on a national level. As one top higher education official described:

It really is hard to talk about Race to the Top in isolation, because what we have in Tennessee—and it's probably true in every state, I just haven't been there, don't know, but the whole movement in education, both K-12 and higher education, is a cumulative and incremental process. And what you hope is, and I think what is true in Tennessee and one of the things that puts us where we are at least in terms of expectations of what Tennessee will achieve, is that incremental and that cumulative effect of all the various initiatives that have gone on. So that Race to the Top . . . when I think about Race to the Top, and I think about what we're doing with the Ready to Teach initiative, what we're doing with our completion agenda, what we're doing with dual enrollment—which was part of the Race to the Top initiative—what we're doing with other kinds of connections between high school students and higher education institutions and their programs, we're . . . I think we're more integrated today than we ever have been.

As state education and political leaders worked with consultants to write the RTTT grant, political leaders continued to develop STEM innovation partnerships, particularly in the area of alternative energy. Due to the state's existing partnerships with ORNL and Battelle, the state created a strategy to focus on solar energy with the ARRA funding it received and later with the NSF TN-SCORE grant. All of these existing relationships influenced the direction that postsecondary institutions and governing boards pursued with federal grant applications related to STEM.

Another way in which national networks or external influences have shaped STEM innovations in postsecondary education is through the state's work on the Diploma Project. Tennessee's work with Achieve on the Diploma Project resulted in the adoption of several STEM standards and inclusion of Tennessee in the Next Generation Science Standards initiative. Furthermore, while the focus of RTTT was education reform in K-12, its influence on higher education, particularly in teacher preparation programs, directed other state-level STEM innovations that followed. The result was a continuation of STEM reforms that started on the K-12 side and moved into the next major national education reform movement in higher education

– Complete College America. In a strategic move, Tennessee leaders were able to build upon their successful RTTT grant by leveraging their position as a national leader in education reform in order to bring attention to the administration’s higher education reform agenda. Education policy leaders were able to make the case for why an investment in Tennessee’s higher education system made sense at this point –the state was networked in such a way as to bring resources together to enhance the STEM research infrastructure and create needed reforms in STEM education in postsecondary institutions.

The circulation of professionals between governmental positions in Tennessee and with Achieve as well as state membership in national education reform initiatives supports the notion that the national diffusion model is relevant to explaining how normative isomorphism is occurring among education reform initiatives. The common linchpin among Tennessee’s involvement in several nationally-affiliated reform efforts was its connection to Achieve and the connections Susan Bodary in her role as a consultant with Education First had with many other reform organizations. As Table 3 illustrates, Achieve is supported financially by and connected to seven major non-profit education organizations (and the Oak Ridge Lab) and is a key player in four national reform efforts including development of the common core standards, the education delivery institute, the Next Generation Science Standards initiative, and the Complete College America program. From the initial work with Achieve on the Diploma Project, the state gathered momentum to move from one initiative to the next, nearly all of which included the same networks of policy actors and non-profit associations. For example, as illustrated in Table 3, Bodary who served as a consultant with Education First, formerly worked with Achieve, the Gates Foundation, Complete College America, and with the Ohio Governor on STEM initiatives that connected her to Battelle. Another example is Stan Jones who headed up the Complete

College American program, but also served as a consultant to Tennessee on its higher education reform funded by the Gates Foundation. The overlap of education experts used in Tennessee, the role that former and current Tennessee officials play on governing boards (both Bredesen and Haslam serve on the board of Achieve) or in consulting positions with national non-profits, and also the overlap of state members in national networks indicates how frequently the same policy leaders are driving innovations among members. In total, approximately 31 different network connections with national non-profits were cited in the interviews and document analysis for Tennessee. Table 3 below lists the organizations cited by respondents and supported by references found during the document analysis.

Table 3. Organizational Networks in Tennessee

	Achieve	Battelle	Gates	Carnegie	Complete College America	Education First * Bodary	Education Trust	Ford Foundation	Lumina	Kellogg Foundation	Oak Ridge National Lab
Achieve		X	X	X	X	X	X		X		X
Battelle	X					X					X
Gates	X				X	X					
Carnegie	X				X			X			
Complete College America	X		X	X		X			X	X	
Education First * Bodary	X	X	X		X						
Education Trust	X										
Ford Foundation					X						
Lumina	X				X						
Kellogg Foundation					X						
Oak Ridge National Lab	X	X									

Influence of RTTT Incentives on STEM Innovations

Pressure from the federal system for a state to conform to national standards is another means by which the national interaction model is at work (Walker, 1969). As a federal grant competition, RTTT influenced both state activity and the larger national movement on education reform and specifically raised attention for STEM innovations due to the focus of the competitive focus area. Thus, the influence of RTTT on STEM innovations is evidence of the national interaction model. The RTTT application includes STEM innovations like the development of UTeach sites in four locations, numerous STEM hubs, and platform schools throughout the state that connect K-12 with local industry and additional external stakeholders. Thus, when Tennessee was successful in securing RTTT funds, the wheels were in motion to create additional STEM innovations like TSIN managed by Battelle. Such partnerships were the means by which other industry sponsorship for STEM education and research came about and later were integrated into the 2010 Complete College Tennessee Act. The connectivity between the RTTT grant award and the Complete College Tennessee Act also led to the development of an outcome based funding formula for higher education, which further incentivized postsecondary institutions' work in meeting the state's completion goals.

Tennessee leveraged RTTT funds to assist the state in planning its education reform so that it could be intentional in connecting the various networks and resources together to achieve the public agenda for higher education. As one respondent summarized:

We don't have, you know, you can't find the state planning office because it's not there. So that means that when this extra money comes along that allows you to pay people to innovate and to think about things instead of delivering a direct service, it's a real valuable commodity, and that's what Race to the Top has done.

The early connection with Complete College America meant Tennessee became a forerunner in a new national agenda focused on college completion. Each of the ongoing STEM

initiatives funded by RTTT aligns with the College Completion agenda as it relates to producing more STEM graduates. Thus, the work started under the RTTT grant has a direct correlation to the work Tennessee is doing with the Complete College America program.

Influence of Regional Neighbors and Ideological Similarities

The Tennessee case illustrates the important role that networking plays in advancing policy innovations and the presence of the national interaction model. While the policy actors involved in Tennessee's STEM innovations were connected nationally through professional and non-profit organizations, however, there is little evidence to suggest that regional influences played a role in these networks. Walker (1969) suggests that some states serve as regional leaders in policy innovations whereby other states within the regional group refer to them. When asked what states were looked to as examples of best practice related to STEM, only the SREB states of North Carolina and Texas were mentioned by respondents. Outside of the SREB, interview and document data frequently referred to the influence of Ohio's STEM Network and the work that Battelle did in Ohio. As will be discussed in later chapters, the absence of Southern states among RTTT grantees and the lag of Southern states outside of North Carolina and Florida in institutional funding for research and development, means that states are looking nationally for best practices in STEM rather than regionally. While there is some examination of what specific research universities in the South are doing, the only state that appears to be getting regional attention for STEM education reform is Texas, which has gained national attention for several years – particularly its UTeach program. Essentially, it seems that Tennessee considers itself the leading SREB state for STEM innovations on a statewide level.

Perception of Competition with Neighboring States for Resources

During an economic crisis, one would expect to hear mention of how competition for funds became more intense. Regional diffusion suggests that competition between institutions and between states encourages states to innovate and look to neighboring states as “competitors” for resources (Walker, 1969). What is interesting about Tennessee, however, is that the state had a need for more funding for education before the economic crisis and state leaders were making efforts before the recession to position Tennessee to take advantage of federal funding opportunities to advance the state’s education goals. What changed after the economic recession was a more focused approach to securing funding from non-profit organizations rather than just relying on federal funding. For example, assistance from the Gates Foundation provided resources not only for the writing of the RTTT application, but also allowed the state to use external experts to create a higher education reform agenda for the Governor’s Office. Because of the economic recession, states are increasingly competing nationally, rather than regionally for grant funding from non-profit organizations. The lack of state funding means states are motivated by national reform efforts tied to financial incentives – indirectly competing with each other rather than adopting policy that directly competes with other states.

In the case of institutional STEM research, little changed in terms of the perception of competition for resources. Several respondents commented that for UTK, as the state’s flagship, the primary focus in STEM is to move up into the top 25 institutions with federal research funding and to continue to collaborate with the ORNL on STEM related projects. As one institutional research administrator explained:

In terms of competitors, I guess we’re kind of competing against everybody in one sector or another but, relative to the institutions that we think are the institutions that are performing at the next level that we need be able to compete better in order to compete like them, this institution has chosen Clemson, Georgia, Purdue, Texas A&M, Minnesota,

Rutgers, Michigan State and Indiana as the next level up. But, clearly, in any given funding competition opportunity, we're competing with anybody from everywhere. So, we're competing from the number one school, you know, right on down.

For all practical purposes, it's federal funding that drives the whole STEM research initiative either directly or indirectly. You know, we did an analysis on our campus just to demonstrate that. Half of the money that comes to us from industry to do projects... half of that money came from the federal government to the industry. Most of the money that the state agencies give to us to do projects—they got the money from the federal government.

Again, the availability of external consultants uniquely positioned Tennessee to receive non-profit financing early in the process, and allowed the state to leverage this success into other funding opportunities. As a result, Tennessee leaders feel many states are now looking to them as a national leader as opposed to Tennessee feeling it must compete with its neighbors for resources. Tennessee, however, is competing nationally for grant funding through non-profit organizations to secure additional resources to support the education reform efforts advanced by their successful bid for RTTT funding.

Institutionalization of STEM Initiatives

Elements of diffusion theory support how policy innovations are institutionalized, but what makes institutionalization different from diffusion is the emphasis on how rules or procedures are built to support the legitimization of the innovation. Due to Tennessee's governance structure for higher education, statewide change largely occurs through the approval of the state legislature or through an executive order by the Governor's Office. This process also lends itself to the institutionalization of processes and expectations. One may examine how the institutionalization of STEM processes occurs and why particular institutions are given responsibility for STEM innovations by analyzing the case against two forms of isomorphism: mimetic isomorphism (where institutions imitate widely used organizational practices) and

normative isomorphism (where professionals circulate within their own systems and share best practices).

UTeach is an example of how states can replicate a program in such a manner that it gains national creditability as the leading method by which to implement K-12 STEM reform. Tennessee was in search of a way to reform STEM education and did a national hunt for programs with proven effectiveness. State officials based the decision to replicate the UTeach program on evidence presented at national conferences and upon the recommendation of external education agencies. The spread of UTeach to other states was only strengthened once Tennessee won the RTTT grant as many of the states applying for second round funding added UTeach into their applications. The spread of UTeach sites nationally as a common organizational practice illustrates how mimetic isomorphism is occurring.

As mentioned in a previous analytical dimension, Tennessee funnels STEM related research to its flagship institution, UTK. The importance of legislation in institutionalizing expectations and the types of STEM innovations that must occur is significant. As one education official explained:

When we passed our Complete College Tennessee Act, one of the key things embedded in that were two STEM initiatives regarding the economic development. One was establishing a research consortium out in Memphis. The other one was really buying into energy resources as a viable STEM field at UT, establishing a Ph.D. there, establishing a direct partnership between UT and Oak Ridge National Lab, like, you know, embedded within the law.

Although contested by the University of Memphis, the assumption that the state's flagship university should take the lead in all STEM innovations so it can compete nationally and improve its rankings with research is an unspoken understanding in the state. As one senior education official stated:

One of the . . . now the unwritten elements of our Complete College agenda that was well understood in conversation, but it didn't really lend itself to writing it into the statute, is that Knoxville is to become the top 25 of public research universities as quickly as they possibly can. So, they're focused on that, and they're moving toward that much to the disapproval of the folks at the University of Memphis—they resent that. They want to be the flagship—they're not—but they want to be. Knoxville is a flagship, and while they're not in my system, they're the flagship, and we ought to support that because the better they do, the better we all do. I think North Carolina . . . the higher education system in North Carolina is better off because of Chapel Hill. I think the Georgia System is better off because of the University of Georgia and because of Georgia Tech. You know, they're kind of co-flagships in those areas.

The expectation of UTK serving as the flagship and striving to compete nationally for research funding is also supported by the following goal statement found in the Complete College Tennessee Act (2010): "Elevate the status of the University of Tennessee, Knoxville as a top tier national research institution through expanded collaboration with the Laboratory" (T.C.A. § 49-9-1501, pp. 5).

The institutionalization of a broad network of STEM initiatives was intentional, said another senior education official:

Working with Battelle, and working with some consultants that had worked with Battelle, was really how we got more into the idea of what does a broader network need to look like, how do we develop something like that, and then how do we think about institutionalizing it in Tennessee.

Therefore, Tennessee's governance structure created an environment where legislation outlined state priorities for reform. *The Public Agenda for Tennessee Higher Education* (THEC, 2010) states that the primary impetus for 2010-2018 higher education master plan is to support the mandates found in the CCTA legislation. For Tennessee, legislation plays a significant role in institutionalizing STEM innovations in the state.

Involvement of the State Higher Education Agency in STEM Innovations

The primary question of this study is to examine how STEM innovations rise to the state's governing board agenda during a period of economic crisis. In the case of Tennessee, the first way in which STEM innovations rose to THEC's agenda was through the funding arrangements that encouraged the institutionalization of STEM innovations that the state identified as priorities. In the case of RTTT, THEC's primary focus is the coordination of a public agenda for higher education with an emphasis on common core standards, management of UTeach sites, the administration of the outcomes based funding formula which has STEM components, and enhancing access and completion rates for college students – particularly in STEM fields. For TBR and UT, the additional focus of the coordination of institutional partnerships to leverage resources for federal research dollars is on the governing boards' agenda.

The Tennessee Higher Education Commission is a coordinating agency for the state with close ties to the legislature. As such, THEC is the main policy actor in directing STEM innovations for higher education at the state level. The primary emphasis in STEM is on teacher preparation and extending the pipeline for students to enter STEM fields. THEC centrally coordinates the UTeach sites including providing budget oversight for the program – something other states do not do. A senior official at THEC describes the state's approach to managing UTeach this way:

...no one else manages their sites centrally, and that's a very . . . when we think about governance, I think that's a very key point. So, right now, Georgia has a couple of UTeach sites. They don't talk to each other. They're institutional initiatives. We, as a state, determined in 2010 that UTeach is great, but UTeach in a vacuum is . . . in four individual vacuums doesn't move the needle for the state. That central coordination that really only a SHEEO agency can provide is key. So, we manage . . . my office manages all four UTeach sites.

As the main policy actor for higher education, THEC must hold institutions accountable for meeting state education goals. State appropriations to higher education institutions are one mechanism THEC can use to encourage required results. Institutions select five subpopulations that are important to their mission and THEC then measures institutions on student access and student success in those areas, STEM degree production is one area that institutions can select (THEC, 2010).

Another way in which STEM innovations ascend to the governing boards agenda is through economic development demands and the opportunity to secure additional federal research funding. As discussed earlier, Tennessee has a longstanding relationship with the ORNL, which fueled its interest in alternative energy research initiatives. Through funding provided by the ARRA, Tennessee created opportunities to attract alternative energy industries to the state. In order to further leverage the state's position to secure additional federal funds, TBR, UT, and several TICUA institutions developed the EPSCoR funded TN-SCORE program.

In the case of Tennessee, national attention for their success has fueled additional external stakeholders to approach THEC to get the state's support for other reform initiatives. A senior official at THEC described the situation this way:

One of the things going on in Tennessee right now, that I've seen first-hand, is success begets success, and Tennessee is on the map right now for a bunch of different reasons. And so we have a lot of externals showing up with what they think we should do. First is, what maybe we need to do for our citizens. And, you know, where we can meet in the middle, we do, but a lot of the externals show up with their solution to our problems versus like the solutions that are probably actually better than the problems.

Conclusion

The Tennessee case illustrates how a well-designed road map for education reform and affiliation with various national networks can drive STEM innovations within higher education in such a way as to pull together various external funding sources to achieve the SHEEO's

statewide goals. The role of professional networks in the advancement of STEM initiatives helped to bridge connections between various national non-profits in moving the state towards the common goal of enhancing K-12 teacher preparation in STEM as well as increasing student preparation in STEM. Meanwhile, addressing deficiencies in STEM education in K-12 meant that students continued in the education pipeline and would enter postsecondary institutions with better preparation for STEM fields. While state leaders focused on K-12 reform, research universities continued to work independently in STEM innovations. Largely funded through federal research agencies, higher education institutions benefited from research funding that connected STEM students through enhanced research opportunities with the Oak Ridge Laboratory and with state industries in alternative energy. In some cases, these institutional efforts would rise to the SHEEO agenda when industry demands required academic programs or research facilities. The other way in which STEM innovations rose to the SHEEO agenda was through the RTTT reform initiatives that became connected to the college completion agenda. When the Gates Foundation became interested in assisting Tennessee with its higher education reform efforts, the availability of private funding sources shifted Tennessee's focus - resulting in the Complete College Tennessee Act.

CHAPTER FIVE

GEORGIA: CONTINUATION IN POLICY THOUGHT

Introduction

When the RTTT grant application was announced, Governor Deal commented that he felt the federal government had taken a play from his playbook. The RTTT grant closely aligned with the education reform initiatives the Governor was pursuing already. As a state, Georgia was already addressing a shortage in STEM teachers in K-12 education and looking for ways to extend the STEM pipeline between high school and postsecondary education. Thus, the state viewed the availability of RTTT funds as the means by which to extend funding for STEM innovations already underway and create additional incentives for the state's K-12 systems to connect with higher education. The Georgia case illustrates how federal incentives for education reform, in the absence of extreme network pressures, can be shaped to fit the state's agenda rather than shifting a state's focus to meet the needs of external stakeholders.

This chapter comprises three sections. The first section summarizes the governmental and educational structures in Georgia. The second section outlines a narrative chronology, first by reviewing the events already in play prior to the 2007 recession, then highlighting seminal events or actors of the STEM innovations that were included in the Race to the Top application, and concludes with statewide STEM occurring outside of the RTTT efforts. This section relies heavily on interview data, which are presented in large segments at times, and archival documents for background and corroboration of interview data. The final section presents an

analysis of the Georgia case by utilizing the six dimensions of the analytic framework drawn from two diffusion theories and institutional theory.

Overview of State Context

Governmental Structure

In this section, I describe briefly the governmental structure in Georgia which includes a description of the executive and legislative branches, their leaders, and composition of the membership of the general assembly. A description of the formal powers and characteristics of the executive and legislative branches provides context for a greater understanding of the environmental influences that may play a role in the state's actions around STEM innovations arising during a period of economic recession.

Sonny Perdue served as Georgia's Governor from January 2003 until January 2011. He was the first Republican governor to serve in Georgia since 1872. His agenda as governor focused on education, health care, job creation, and safety. Until the election of Perdue, Georgia had Democratic governors for 130 years. This was the longest single party domination of a governorship in the nation's history. Nathan Deal succeeded Perdue as Governor in January 2011. Deal is also a Republican and previously held the U.S. House of Representative seat for Georgia from 1992 to 2011. Deal's campaign platform for education included support for charter schools that have a STEM focus.

The governor appoints eight cabinet-level officials, although there is no formal cabinet system, as well as lay members of several statewide boards and commissions. Overall, the appointment powers are quite limited with several executive departments in Georgia headed by elected officials who are independent of the governor. Most state agencies are formally headed by policy-making boards, and not by the governor or a single person appointed by the governor.

Terms of office for these boards are often staggered to prevent a particular governor from appointing the majority of the membership. As of 2007, overall personal and institutional power of the governor was scored at 7 on a 10 point scale (Beyle & Ferguson, 2007). The size of the governor's legislative staff compared to the congressional staff is highest compared with the other two states in this study (Squire & Hamm, 2005).

Like the governorship, Democrats have historically held majority control of the Georgia General Assembly. A shift in control came about in 2002 when the state Senate became majority Republican for the first time since 1870. In 2004, Republicans gained control of both houses. According to Squires and Hamm (2005), Georgia has 3.21 house members per senator with members in the House and Senate serving two-year terms. Georgia ranks 37th in terms of legislative professionalization, which is below the median of all states (Squire, 2007). Each house and Senate member has year-round personal staff at both the capitol and in their district as well as professional and clerical staff support. In 2007, Georgia had 34 Republican Senators and 22 Democratic Senators (CSG, 2007). During this time, there were 106 Republicans and 74 Democrats in the House. At the time of the Race to the Top grant application, there was little change in terms of party control in both houses (34/22 in the Senate and 107/73 in the House) (CSG, 2009). In 2011, Republican control only strengthened as the Senate added two Republicans to increase the total to 116 (CSG, 2011).

Higher Education Structure

The Board of Regents of the University System of Georgia (USG) functions as a single governing board over 31 public institutions in the state. Established in 1932, the Board received constitutional authority in 1943 to plan and coordinate a consolidated budget and program approval for institutions of higher education in the state. The governor (with the consent of the

senate) makes appointments to serve on the 15-member board. Members of the board serve seven-year terms. There is not a statewide state office of secretary of education, nor does the Board of Regents function as a cabinet department. The Board appoints the Chancellor of the University System (McGuiness, 1988). In 2011, the Board appointed Henry “Hank” Huckaby as Chancellor of the USG. Huckaby served as a Georgia House Representative prior to his selection to be the Chancellor. He was preceded by Erroll Davis, who served as the System Chancellor from 2006 to June 2011. Davis moved into the interim position of Superintendent of Schools for the Atlanta School District in 2011 and continued to serve in this role through 2012.

There are four public research universities in the State of Georgia: University of Georgia, Georgia Tech, Georgia Health Sciences University, and Georgia Southern University. Prior to 2012, there were 35 institutions within the USG. In fall 2011, Chancellor Huckaby announced the consolidation of eight campuses within the system into four universities. The consolidation of these institutions began in 2012 and included the Georgia Health Sciences University consolidating with Augusta State University. As the first land-grant institution and one of the oldest public universities in the country, the University of Georgia is considered the states’ flagship university. Georgia Tech, however, is the primary player related to STEM related research and initiatives. In 2012, Bainbridge College was the only remaining two-year institution in the state, but received permission by the Board to move into offering four-year degrees and become a state college.

While many of the state colleges offer bachelor and associate degrees, the technical college system is the primary avenue whereby the state confers associate and certificate degrees. The technical college system is governed by the Technical College System of Georgia (TCSG), which is an independent governing board comprised of 21 members representing each

congressional district and eight at-large members. Twenty-five technical colleges and 31 satellite campuses comprise the TCSG system. The TCSG Commissioner, Ron Jackson, has served as the Commissioner since 2008.

Georgia's Independent College Association (GICA) is a membership association for the private institutions within Georgia. The association works on behalf of 25 member institutions on public policy, research, fundraising, and collaborative programs. In the most recent *Chronicle of Higher Education Almanac* (2012), Emory University ranked 28th in university research and development spending financed by the federal government for fiscal year 2010. This is the third ranked institution from within the three states included in this study - with Vanderbilt and Georgia Tech at 23rd and 25th, respectively. The institution reports that in fiscal year 2012, Emory received \$518.6 million in external funding with federal agencies awarding more than 93 percent of the total to its Woodruff Health Sciences Center (Emory, 2012). Emory University is not a member of GICA.

Narrative History of Events and Policy Actors

This section provides a narrative chronology of how STEM innovations came to be on the state governing board's agenda. State education officials were working on several initiatives prior to the economic recession and a network of policy actors connected to national non-profit education organizations influenced not only the direction taken with STEM innovations, but also the funding opportunities made available to Georgia. Overall, state leaders largely maintained the work already underway in STEM, incorporating STEM into the reform plan only because it was a competitive area in the application rather than more intentionally creating new connections to industry and non-profit reform agendas. Synergy between institutional or industry research seems largely absent, instead the focus on teacher preparation and recruitment in STEM and

increasing the STEM pipeline continued to dominate the STEM focus at the state level. Thus, the Georgia case illustrates how the absence of an extensive network of policy actors largely left the state to work internally on its existing federal projects, rather than shifting focus in response to national non-profits that sought to provide funding opportunities to push particular STEM agendas. Before describing the seminal events and actors, this section first provides the background of what was occurring in Georgia prior to Race to the Top grant application.

Antecedents to the Race to the Top Grant

Perhaps the most well known research initiative in Georgia's history is the formation of the Georgia Research Alliance (GRA). Founded by a group of Georgia business leaders in 1990, the GRA is an intermediary organization that "brokers" deals between university-based research and private industry (GRA, 2013). One specific program funded by the state through the GRA is the eminent scholars program, which recruits leading scientists and researchers to the state's higher education institutions and fosters institutional collaboration on federal research projects. The GRA is also an example of how a state fosters technology creation by using state funding to build research infrastructures and technology that can lead to private investment and commercialization of innovations (Geiger & Sá, 2005). The GRA reports that the agency has, "leveraged \$565 million in state funding into \$2.6 billion of additional federal and private investment" (GRA, 2012, p. 17).

In 2007, Congress reauthorized the America COMPETES Act and provided additional appropriations through the ARRA of 2009 to the National Science Foundation to support the Math and Science Partnership Program (MSP), which is a joint effort with the U.S. Department of Education. The MSP program provides merit-based grants to teams of higher education, local K-12 school systems and supporting partners in their work to raise educational standards in

STEM fields (NSF, 2010). What sets the MSP program apart from other STEM education reform initiatives is the requirement that STEM faculty from higher education partner to address K-12 math and science education issues, particularly through a program referred to as PRISM (Partnership for Reform in Science and Mathematics).

In 2007, the USG, in partnership with the Governor's Office, the Georgia Department of Education, and the Georgia Professional Standards Commission (the state agency responsible for teacher accreditation), saw participation in PRISM as a way to address the shortage of STEM graduates/teachers in the state. PRISM is a five-year grant program with a three-fold goal: increase the number of K-12 students interested in STEM; increase the number of college students graduating with STEM degrees, and increase the number and quality of STEM teachers in middle and high school science and math (USG, 2007). The USG's involvement in the first phase of the project included taking a national pilot program titled, "Project MESA" (Mathematics, Engineering and Science Achievement), and coordinating implementation at the access institutions in the state to help educationally disadvantaged students succeed in STEM disciplines. Ultimately, the objective of the pilot program was to identify what worked well in order to replicate MESA as part of the PRISM initiative. In the second phase of the grant, USG and its partners gathered evidence on how and to what extent the PRISM strategies worked to change the culture of STEM education in the state through professional standards, collaborations between school districts and higher education, and through a public awareness campaign. The culminating work will result in replicable models for implementation across the state.

Because of the state's participation in PRISM, USG simultaneously created their "USG STEM Initiative" to connect its broader STEM focus to the work of PRISM. The goal of the initiative advances the goals of PRISM through a concentrated focus on expanding the STEM

pipeline from high school to college. The initiative consisted of a consortium of seven postsecondary institutions that work with local school districts to get more high school students interested in STEM, and then transition those students to be successful in freshmen STEM gateway courses. The Office of Educational Access and Success at the USG, which provided funding to USG institutions to participate in the program, lead the effort. USG provided funding in four major areas: 1) through mini-grants to faculty; 2) through partnerships with school districts and postsecondary institutions to bring STEM majors into K-12 classrooms (titled “Fostering Our Community’s Understanding of Science” or FOCUS); 3) to two-year institutions to increase the number of educationally disadvantaged students entering four-year degree programs (MESA); and, 4) for recruitment efforts in high schools to encourage student consideration of teaching math or science in urban areas (referred to as the Academy for Future Teachers) (OEAS, 2012; USG, 2012).

While the state had secured federal funding for STEM initiatives through NSF’s Mathematics and Science Partnership Program, other efforts were underway by federal leaders to secure Georgia’s support for educational reform that would later be part of the RTTT grant. In fact, many of the respondents cited that it was an easy choice for Georgia to decide to apply for RTTT funding because the educational agenda of the Governor’s Office closely related to the national reform efforts that the U.S. Department of Education would later build into the RTTT grant. A former government official recalled how U.S. Secretary of Education, Arne Duncan, sought out support of the Governor:

Governor Perdue would tell you . . . he said this in a number of public meetings that he felt like Arne Duncan stole a play from his . . . Perdue’s playbook—that everything that was a priority in Race to the Top had really been a state priority, and so the resources that were going to come with Race to the Top were really to accelerate and deepen and extend the work and the plans that we had in Georgia.

Governor Perdue, was very, very interested in that and felt like the partisanship that had often been associated with education reform at the federal level had sort of been removed from this administration. In that, you know, there was not really a conversation about Democrats versus Republicans. It was really about education reform, and I think that appealed to a lot of different states.

Once the federal government announced the RTTT grant, state leaders pulled from their previous work in education reform to build the foundation for the grant application. At the cornerstone of RTTT STEM plan was the work that the Alliance for Education's Math Science Task Force had undertaken. Governor Perdue created the Alliance for Education in 2006 with the goal of bringing together education agency heads and state government officials to collaborate on policies and programs. The task force was a legislatively appointed study committee charged with looking at ways in which to recruit and retain high quality K-12 math and science teachers. Two major recommendations from this group included: 1) elementary teachers who earned endorsements in mathematics or science qualified for \$1,000 stipend every year and 2) differentiated pay for secondary math teachers. As one former government official described the intent of the differentiated pay proposal:

Teachers who had between zero and five years experience, who were certified as math and science teachers in grades 6-12, were able to come into Georgia and be paid as if they had five years of experience already. And so, it was very much a recruiting tool to get very strong content teachers into our middle and high schools across the state.

In March 2009, the General Assembly passed HB 280 that gave legislative approval for the differentiated pay schedule for math and science teachers and stipends for elementary math and science endorsements starting in the 2010-11 school year (Alliance, 2009).

At the time of the RTTT grant announcement, these legislative decisions, in conjunction with the educational structure and previous success in Georgia, caught the attention of external funding partners looking to support educational reform in STEM. As one government official who worked with Governor Perdue explained:

[What we] already had in place was in regards to our teacher licensing around STEM innovation and education. You know, we had already separated out how we licensed our STEM teachers, which gave us a little bit of an advantage in the K-12 arena. I think Georgia had also sort of separated itself as having a strong University System and Technical College System as we look at STEM sort of beyond just, I guess, four-year degrees and beyond. So, I think the support that we had provided in those two areas gave us a strong foundation in moving forward with some of the opportunities Race to the Top gave us.

Governor Perdue's political agenda supported charter schools, which also garnered attention by national education reform organizations. Arne Duncan gave strong support for charter schools through the RTTT grant, creating a favorable position for Georgia in its bid for RTTT funds – even though the Charter School Commission in Georgia would later be ruled as unconstitutional. With the state's differentiated pay for STEM in place, the administrations' focus on charter schools, and the state's right-to-work laws, there was a close alignment to RTTT priorities – positioning the state to be competitive in the RTTT grant competition. The likelihood of Georgia's successful bid for RTTT funding led the Gates Foundation to select Georgia as one of 15 states that would receive financial support for consultants to work on the RTTT application for the state.

So, while the RTTT grant application advanced particular educational reform ideas – particularly in STEM, Georgia saw the grant as a funding opportunity to move the existing work forward rather than an initiative that required new thinking about STEM. Georgia's involvement in the Teach for America program and the New Teacher Project, which was already in place in Atlanta schools, are two examples of programs government officials wanted to expand through the RTTT grant. The Teach for America program recruits recent graduates to teach for two years in urban and rural public schools. As an Americorps sponsored program, participants also receive education awards to cover educational loan repayments. Both initiatives would later be

included in the RTTT grant in the creation of an “Innovation Fund.” As one higher education official explained:

Race to the Top was seen as a way of accelerating that work and so it . . . I think . . . I think it would be safe to say that the people that actually made that decision viewed it as a way . . . something that was very aligned to the direction that Georgia was taking and would infuse, obviously, significant dollars to that work.

Rise of the Race to the Top Grant Application

When the Gates Foundation stepped in to provide \$250,000 for a consulting group to assist Georgia in writing its RTTT application, Georgia officials reviewed prospectus files from seven agencies and selected Parthenon Consulting Group based in Boston, Massachusetts. None of the respondents, however, specifically cited individuals from the firm who led the work. Instead, the focus of responses was on the coordination done by the Governor’s Office and key state governing boards. Key players included representatives from the Governor’s Office and staff from DOE, USG, TCSG and the Professional Standards Commission. State leaders created four assurance groups focused on each of the major areas of the grant and then a fifth group that provided feedback on the ideas at several different checkpoints in the grant development.

A former government official stated that a major influence on what to include in the grant came out of an examination of what was required in the application, the policy priorities of the state, the work already in play, and what they could leverage in the application to help them accelerate those projects. One higher education official described how the absence of long-term federal funding for the PRISM initiatives fed the decision to include the previous work of this initiative into the grant:

There was legacy work because of PRISM and some other initiatives that had gone on that they could build on that and go after some other external money to see some of that work forward.

Despite the need for funding for current STEM initiatives, one higher education official felt that the major focus was on teacher preparation and the longitudinal data system, not STEM. In many ways, greater emphasis in these areas was because teacher preparation and the data system were seen as foundational elements that would later enhance STEM initiatives. In fact, one government official cited that STEM was not on the Governor's agenda at this time. As the official stated:

The reason that we focused so much on STEM was because there was a competitive preference for STEM programs. So, I mean, now . . . now, nationally, everybody is looking so much at STEM education, but that wasn't as much on our radar when we were putting together Race to the Top, and that's really one of the reasons that . . . that there is so much of a STEM focus within our Race to the Top proposal. So, I think it's been a good thing, but that definitely pushed us in the right direction—the fact that there was that competitive preference.

The assurance groups looked at the work of the Math Science Task Force and the work of the PRISM project to decide what to include in the RTTT application. For example, the awareness campaign that had been developed through PRISM—Math Plus Science Equals Success was pulled into the RTTT application in an effort to broaden its scope and take it further. The assurance groups also looked at the existing Science Mentor Program sponsored by the Georgia Department of Education.¹ The mentor program consisted of 16 different science mentors that were assigned regionally in the state. These science mentors went into schools where there were demonstrated challenges with STEM education and worked with teachers to strategically identify where they needed to bolster instruction to help their students get a deeper understandings of science concepts. The ultimate goal of the program was to have students demonstrate their knowledge and understanding more effectively on the graduation test.

¹ Stephen Pruitt, who started Georgia's Science Mentor program, would later go on to serve as vice president at Achieve with responsibility to work on the Next Generation Science Standards.

One new statewide initiative included in the RTTT application was the replication of the UTeach program. State leaders became familiar with the UTeach program through their association with the Math Science Partnership (MSP) program. Georgia state officials had a similar experience to other states in that they gained an awareness of UTeach through national conference presentations. At these conferences, UTeach leaders shared data on the success of the program to education leaders who were part of MSP, which then helped to get the word out about the program. UTeach, which began at the University of Texas at Austin in 1997, is a program focused on preparation of college students to become secondary science, math, and computer science teachers. As a pipeline program, each institution's College of Education and College of Natural Sciences work collaboratively to prepare and recruit more STEM teachers.

Georgia officials approached UTeach to begin the conversation about bringing the program to Georgia at the same time that the differentiated pay program was under consideration. One former education official explained the questions and ideas the state was exploring with UTeach leaders at this time:

(We explained how) this fits actually very nicely with the math science differentiated pay program that we're putting in place for our secondary teachers. (We asked ourselves) is there perhaps another partnership with UTeach and several universities throughout Georgia that would mesh very nicely such that, you know, as we're doing a better job preparing these math and science teachers in our higher ed institutions, then we have also a way to place them in the schools and compensate them at higher levels?

With the alignment of existing statewide initiatives to RTTT goals, Georgia submitted its RTTT application – but earned third place honors in the first round. Policy leaders felt strongly that they did not need to do much to revise the plan and made minor revisions for round two - after looking at the Tennessee plan for ways to strengthen their application. One government official described what occurred between phase one and two:

Governor Perdue had a meeting with Secretary Duncan between phase one and phase two, and he essentially said to Secretary Duncan, “I think we had the right plan the first time around, and so we don’t intend to change very much in round two.” And Duncan said, you know, “If you think that’s the right way to go, then absolutely go that way.” And so, that was Perdue’s very strong feeling because, like I said, this was not a . . . making up an entirely new plan. This was stay in line with what the state plan or intentions had always been.

The second thing was that, if you go back and look at round one, there were five different reviewers, and if you look at the five reviewers comments, they contradict each other all over the place. So, we went through and really looked for consistency across reviewers’ comments. In what places are the four or five reviewers saying essentially the same kind of things and then let’s use those to modify the plan. They talked . . . all of them talked about how our application in round one had been very heavy on teachers, and we didn’t say as much about leadership development. Another big piece of it was that we found out shortly before the round two application deadline that we did not get the longitudinal data system grant from IEF², and so we had to build the IEF grant application into our Race to the Top application and find \$14 million in Race to the Top to support that work.

The Department of Education announced the second round winners in August 2010 and Georgia placed eighth out of 10 states selected to receive RTTT funds (AJC, 2010). With \$400 million in hand, the state began moving forward with the continuation of education reform work, and introduced two new programs to Georgia: the UTeach program and the Innovation Fund.

RTTT and Higher Education Institutions. As required by the RTTT grant criteria, the Georgia RTTT application engaged higher education institutions in several initiatives focused around teacher preparation and partnerships with school districts. It was also important to have USG support for the longitudinal data system, since every institution would need to be involved. State leaders therefore saw the data system as a critical component of how RTTT connected with higher education in the state.

After receipt of RTTT funding in round two, one of the new initiatives introduced to the state was Georgia’s Innovation Fund. Based on the state’s previous work with the Teach for America and New Teacher Project, the Innovation Fund was to provide funding to school

² The 2010 U.S. Innovative Education Forum (IEF) is part of the Innovative Teachers program, sponsored by Microsoft’s Partners in Learning program.

systems to encourage their partnership with higher education institutions, non-profit organizations or businesses to innovative in STEM education. The Innovation Fund, which had \$19.4 million set aside from the RTTT funds, had four priority areas: applied learning for students inside and outside the classroom, teacher induction programs, expanding the STEM teacher pipeline, and increasing the number of STEM charter schools. One of the Innovation Fund priority areas is modeled after these programs to increase the availability of STEM teachers in underserved and disadvantaged areas (GOPB, 2011).

While institutions largely did not weigh in on the initial RTTT grant application, the Innovation Fund became a major avenue in which higher education institutions sought out partnerships to advance STEM initiatives. For example, Georgia Tech modeled the STEM pipeline program on the Teach America program with the intent of directing STEM majors to work for two years in rural Georgia schools that have difficulty in recruiting STEM teachers. The induction programs funded through the Innovation Fund involved University of Georgia and Georgia State on teacher preparation with the institutions collaborating with surrounding counties and the Georgia Association of Education Leaders (Georgia Office of the Governor, 2012).

The Governor's Office of Student Achievement is the agency that handles the review and monitoring of the Innovation Fund programs. The Governor's Office of Student Achievement awarded two rounds of Innovation Fund awards by 2012, and was getting ready to move into the review process for the third round. An advisory panel made recommendations to the Governor on finalists for grants and the Governor gave final approval. Representatives from private business, foundations, higher education institutions and K-12 comprised the advisory panel. Out

of the items included in the RTTT grant, the fund was a major policy lever to affect innovations in postsecondary education.

The Math and Science Partnership Program also indirectly influenced what was included in the RTTT application through the STEM innovations already underway through the work of the Center for Education Integrating Science, Mathematics, and Computing (CEISMC) at Georgia Tech. CEISMC provides faculty partners to Georgia schools, educational groups, and businesses. The primary goal of CEISMC is to provide training for K-12 STEM teachers and educational preparation for students in STEM (CEISMC, 2012). In fact, one government official stated that the working relationship between Georgia Tech and the Governor's Office combined with the work already underway at CEISMC, made the Governor's Office very comfortable with selecting them as lead institution in the STEM plans.

One example of CEISMC's work is the teleconferencing project between Georgia Tech faculty and Barrow County Schools. Secondary school students can watch as faculty conduct and explain their research. Georgia Tech's work with Barrow County schools provided an example of how initial funding through the Innovation Fund lead to additional funding support for a specific initiative. One government official described the excitement of how these types of innovations lead to other funding opportunities:

And the best thing about that I think is that because it's been successful with this sort of minimal state investment, is that they've now been able to go out and get other federal grants, and they've kind of watched the partnership expand and grow beyond this initial investment of Race to the Top dollars.

A third of the Innovation Fund grants, approximately \$7 million in RTTT funds, have gone to Georgia Tech sponsored or co-sponsored programs (GT, 2010). What is particularly interesting about this arrangement is that Georgia Tech is the only institution without a College of Education in the state. In spite of this fact, government leaders selected Georgia Tech to work

on RTTT initiatives. Government officials cited that this decision was based on the fact that Georgia Tech was involved in STEM education before the RTTT grant application came out and RTTT funds only deepened those partnerships. In fact, CEISMC continued to lead the STEM education effort beyond Perdue's term in office at the bequest of Governor Deal. As one government official stated:

Governor Deal met with the president of Georgia Tech and really asked them to kind of step up on their involvement in education because they have so much to offer and he has done a great job of making sure that they're really involved.

Moving Forward: Tying STEM to College Completion

The college completion agenda had been on the minds of higher education and national non-profit reform organizations for years, but gained greater attention immediately after the federal government awarded RTTT funds. With the introduction of the Complete College America program, a new national movement with financial support from several non-profit organizations came to the forefront of the national agenda for higher education reform. Georgia was the 22nd state to join the Alliance of States in the Complete College America initiative and was one of 10 states that received a \$1 million grant through the Complete College America program, funded by the Bill and Melinda Gates Foundation (Office of the Governor, 2011). Higher education and government officials cited that they looked to Tennessee and Oklahoma as the forerunners of this movement.

Governor Deal's completion agenda lays out the importance of USG continuing its work on the STEM Initiative and the introduction of a new remedial mathematics program, "Quantway," funded by the Carnegie Foundation for the Advancement of Teaching (USG, 2011). The Governor's completion plan also includes the formation of the Higher Education Finance Commission, which will examine how the state's funding formula can be modified to

incentivize completion (GOG, 2011). Both the completion plan and the executive order that created the Higher Education Finance Commission support Governor Deal's strategic plan (GOPB, 2012). As such, the availability of funding through the Complete College America program advanced the Governor's initiatives during a time of limited state revenues.

Under the vision laid out by the Governor's strategic plan and the Complete College Georgia plan, USG is trying to leverage the USG STEM Initiative to be a policy lever for driving additional change in STEM innovations in postsecondary education in Georgia. As part of Complete College Georgia, USG is now looking across the system at STEM as a focus for the completion work. Through the Mathematics, Engineering, Science Achievement (MESA) program, for example, the USG desires to fund initiatives to increase the number of first generation, low-income students graduating from high school and moving into STEM disciplines. As one respondent explains:

And it wouldn't surprise me . . . this has not been . . . the ink isn't dry by any means, so it wouldn't surprise me if, with the Higher Ed Performance Funding Commission, if STEM isn't a target area with that. But that's down the road.

The current funding formula for Georgia includes research activity into the calculations that each institution receives from state appropriations. The formula provides an amount equal to graduate academic salaries and factors expenditures for activities specifically organized for research and funds used to leverage other matching funds (sponsored research). Research accounts for 8.7% of the total funding formula. In FY 2013, the formula for research resulted in \$321 million (USG, 2011).

Case Analysis

With the chronological narrative outlined, this section analyses the influences and events of the Georgia case against the six dimensions of the analytic framework. (See appendix D for a

summary chart of the framework.) The central question of this study is to examine how STEM innovations come to be on the state higher education agency agenda. This study uses diffusion models to identify conditions that drive the spread of new policy ideas. As previously described, diffusion models explain how networks communicate about innovations that lead to adoption and institutionalization (Berry & Berry, 2007).

Network Pressures That Influenced STEM Innovations

Georgia is no different from any other state facing increasing pressures from the federal government to reform K-12 education, particularly in the area of STEM. What does set Georgia apart, however, is the position taken by the Governor's Office to act as independently as possible when pursuing these initiatives. While there are several non-profit education reform organizations who are collaborating with Georgia, one higher education official stated they do not feel they are beholden to the dictates of those organizations – it is a partnership. As one government official described the role that the National Governor's Association played in providing ideas for Georgia to include in the RTTT grant:

We were involved with NGA, but I don't recall getting ideas from them for Race to the Top. I mean, we really knew pretty well from the get-go what we wanted to put in there. Governor Perdue made a very specific decision not to involve associations in Georgia in the development of the proposal.

Several respondents indicated associations with Achieve, NGA, and other non-profits, but stated that there was no direct involvement by these groups in the selection of program initiatives for the state. One respondent stated that the Governor's office did talk to Battelle and other value-added and data groups, but ultimately the administration chose not to name one specific organization because they did not want to use the same systems or organizations as Tennessee.

In spite of this claim of greater autonomy, however, there is evidence that several national programs in STEM and teacher preparation have found their way into Georgia's reform

plan. Evidence exists of the national interaction model since officials interacted within national associations to share best practices in STEM innovations. For example, it was through the NGA that Georgia was able to make connection with the Ohio STEM Network – providing ideas for how to implement teacher evaluations. Furthermore, the New Teacher Project and Teach for America programs were used in formulation for the idea of Innovation Fund and RTTT funding supported replication of the UTeach program. A government official described how the UTeach program came to their attention and was then incorporated into the RTTT grant application:

I went to a number of conferences where there were UTeach presenters, so I think they got their name out pretty effectively across the country. They also were very smart at the beginning of their work to collect evidence of their effectiveness along the way.

Conferences sponsored by the Mathematics and Science Partnership, introduced state leaders to best practices like the UTeach program. These associations show how the professional networks lead to the replication of programs nationally and the influence that associations have on the STEM innovations taking place on a statewide level. Like many other states that accepted financial assistance from the Gates Foundation, Georgia's leaders saw an opportunity to leverage initiatives already underway in order to secure additional federal resources. The RTTT grant itself, did not necessarily facilitate unique ideas, but through the state's involvement in professional associations, they were able to notice best practices in other states that they would later be able to include in the RTTT application and, ultimately, led to innovations introduced to the state.

Influence of RTTT Incentives on STEM Innovations

As a federal grant competition, RTTT influenced both state activity and the larger national movement on education reform. The competitive area for the RTTT grant – STEM, provided the initial incentive for states to think about how to implement STEM innovations.

Thus, the influence of RTTT in encouraging STEM innovations is evidence of the national interaction model. In Georgia, with its history of involvement in PRISM (which ended in 2008) and the 2009 legislation to incentivize teacher accreditation in STEM, the primary focus of the initiatives included in the RTTT application centered on accelerating the work already in progress. While UTeach was a new state initiative proposed in the RTTT grant (later implemented at three postsecondary institutions), the primary means by which RTTT incentives influenced STEM innovations in Georgia was through the creation of the Innovation Fund. The primary partner in working on new opportunities through the Innovation Fund has been Georgia Tech and CEISMC. While other institutions with the USG do benefit from awards received through the Innovation Fund, the largest percentage of funding is going to Georgia Tech either through its STEM programs or through CEISMC. This funding largely continues the work already underway and expanding the scope of partners that Georgia Tech is working with on STEM education reform. Arguably, however, the other institutions that are benefiting from the fund are making an impact on the level of STEM innovations occurring around the state in K-12 teacher preparation and extending the STEM pipeline. Outside of UTeach and the Innovation Fund, however, respondents did not specifically state how RTTT incentives directly led to additional STEM innovations in the state.

Influence of Regional Neighbors and Perception of Competition for Resources

Researchers have used regional diffusion models to explain how internal determinants along with information asymmetry and satisficing in decision-making lead states to adopt policy innovations of their neighbors (Berry and Berry, 1990; Berry, 1994; Frost, Hearn, & Marine, 1997; McLendon, 2003; McLendon, Heller, & Young, 2005). Respondents in Georgia varied in their responses about which states leaders looked to for ideas in STEM innovations. For one

government official, Florida and North Carolina were states that served as good examples of how to implement education reform because they are similar to Georgia in terms of state demographics, type of industry, and challenges with low-income areas. Other respondents cited Texas and Ohio for states that had strong STEM initiatives. Other than Tennessee and Texas, respondents did not cite any other SREB state more than once.

Walker (1969) suggests that some states serve as regional leaders in policy innovations whereby other states within the regional group refer to them. In early 2012, the USG collaborated with the Center for 21st Century Universities and the Center for Advanced Communications Policy at Georgia Tech to prepare a report that looked at state-level STEM innovations in the U.S. The primary objective of the report was to identify initiatives comparable to the USG STEM Initiative and to identify best practices from these comparator programs. Of the 43 statewide STEM initiatives identified for the study, researchers identified four states as “leading states” in STEM Initiatives with a postsecondary component: Georgia, Louisiana, Tennessee, and Ohio (OAES, 2012). The report also identified The Ohio Learning Network and the Texas T-STEM initiative as the most comprehensive (both programs received their initial funding from the Bill and Melinda Gates Foundation). With the attention now focused on college completion, respondents cited Oklahoma and Tennessee as states worth paying attention to because they are viewed as the forerunners in the completion agenda.

While Georgia officials do not cite direct competition with regional neighbors for resources, there is evidence to suggest that the state does identify regional pace setters in education reform. Based on the limited responses and reference in the archival documents, it appears that Georgia officials are primarily looking nationally at best practices in the area of STEM. The exception is Tennessee, which officials view as a neighbor who has demonstrated

success not only in the RTTT grant competition, but also as a leader in the college completion agenda. Mention of Tennessee in the document search and in interviews, however, indicated that Georgia views Tennessee as a state to learn from, but necessarily the model that Georgia wants to follow in all cases. Again, several respondents indicated a strong sense of independence in making decisions that were right for Georgia's particular governance structure rather than assuming what works in one state would work in Georgia. This finding is similar to the study conducted by Ness and Mistretta (2010), where the researchers found that the state's unique internal characteristics mitigated the influence of surrounding states.

Institutionalization of STEM Initiatives

Colyvas and Powell (2006) concluded that when legitimacy is low, there is a need to illustrate the public benefit of such an activity in order to gain support beyond the organization. Institutionalization is accomplished through the development of legislation or processes that guide behavior. In Georgia, the state's participation in PRISM led to the institutionalization of teacher preparation programs in STEM across the state. As a pilot program, MESA, was incorporated into the state's strategies to encourage more economically disadvantaged students to enter the STEM field – in an attempt to increase undergraduate interest and graduation in STEM. In the second phase of PRISM, USG gathered evidence of whether the program was successful in changing the culture of STEM education in the state. The goal was to take these successes and replicate them across the state to create a comprehensive reform effort in STEM education. Throughout both processes, the state's professional standards commission was heavily involved. As one higher education official summarized, "PRISM was a \$34 million NSF grant that ended in 2008, and PRISM's legacy is huge. And they built a lot of the Race to the Top language right off of PRISM." The impact of participation in PRISM was felt outside of K-

12, however. For example, within postsecondary education, the PRISM program led to changes in how institutions promote faculty members and tenure policies (BOR Policy Manual, Section 803.27). Furthermore, participation in PRISM led the USG to create the STEM Initiative, which incorporated PRISM into a broad-reaching STEM reform plan for higher education in the state, connecting USG initiatives to local high schools to extend the STEM pipeline.

The state's effort to pass legislation on differentiated pay initiatives for STEM teachers is another way in which STEM innovations became institutionalized. By providing teachers an incentive to not only specialize in science and math, but also receive state certification in those areas, standards are reinforced and encouraged among the profession. In order to institutionalize these standards, state leaders explored how to connect UTeach to the differentiated pay program. Both efforts not only attempt to standardize the STEM curriculum, but also seek to recruit new students into teaching science and math. UTeach is an example of how states can replicate a program in such a manner that it gains national creditability as the leading method by which to implement K-12 STEM reform. State officials based the decision to replicate the UTeach program on evidence presented at national conferences. The spread of UTeach to other states was strengthened once Tennessee won the RTTT grant as many of the states applying for second round funding, like Georgia, added UTeach into their applications. The spread of UTeach sites nationally as a common organizational practice illustrates how mimetic isomorphism is occurring.

Georgia Tech and CEISMC program are the primary players in STEM innovations in Georgia. Respondents cited that there is an expectation that Georgia Tech take the lead in partnering on STEM reform initiatives for K-12, even though the research institution does not have a College of Education. State leaders reinforce this expectation through the institution's

relationship with the Governor's office and through the many partnerships with K-12 school districts in the Atlanta area. As a nationally ranked engineering and technology institution, and the pre-eminent institution in Georgia for these fields, Georgia Tech is positioning itself to direct the STEM pipeline effort so that it can also advance its own goals by recruiting more highly qualified high school students. Its location near the state capital and near the USG central office allows greater access to STEM policy discussions and state policy leaders often refer to Georgia Tech for research assistance. As such, state officials view Georgia Tech as a major contributor in the discussion around STEM innovations system-wide. In many ways, Georgia Tech and CEISMC are helping direct these larger efforts. Institutional theory helps explain how state leaders have institutionalized Georgia Tech's prominent role in directing STEM innovations through unspoken expectations.

Involvement of the State Higher Education Agency in STEM innovations

The primary question of this study is to examine how STEM innovations rise to the state's governing board agenda during a period of economic crisis. In the case of Georgia, the first way in which STEM innovations rose to USG's agenda was through the funding provided by the NSF for the PRISM program. As a result, the USG developed the STEM Initiative to providing state matching funds. This work set the foundation for USG's continued involvement in teacher preparation programs for STEM as the RTTT grant application came out. The emphasis of the RTTT grant on teacher preparation in STEM and the creation of a state longitudinal data system required support of the state's postsecondary institutions. As a centralized coordinating body for all 35 postsecondary institutions, USG naturally would play a role in these discussions. Teacher preparation programs at USG institutions and program

approvals associated with any curriculum changes are coordinated through the USG central office.

Innovation funds are connecting higher education institutions directly to local school systems, so the system office is absent from these arrangements unless it directly ties to teacher preparation curriculum. The other role the system office plays is in providing a venue for institutions to share best practices with each other. So, while institutions are largely autonomous in seeking out grant funds from either the Innovation Fund or other sources, the system coordinates conferences for them to share this information with each other. CEISMC does provide a research assistant to work on initiatives for the USG – again connecting Georgia Tech directly to state level initiatives.

Conclusion

The case of Georgia illustrates how federal and national reform efforts gained entrée into the state's education reform agenda by offering the financial incentives desperately needed during a time of economic recession. While Georgia did not have the network of policy actors working between state agencies and national non-profits that other states may have had, the state did take steps to introduce some of the leading national STEM innovations into its RTTT application (UTeach and the Innovation Fund). The predominant emphasis by the state, however, has been to find financial support for the continuation of STEM innovations already underway. This continuation of policy thought can be seen initially in the support for the USG STEM Initiative through the NSF funded PRISM program, which then was carried into the work of the RTTT grant, and later into the college completion agenda. Institutional actors like Georgia Tech and CEISMC, through specific grants financed by the Innovation Fund, direct all other STEM innovations.

CHAPTER SIX

SOUTH CAROLINA: THE NON-ADOPTER

Introduction

When the federal government offered economic stimulus (ARRA) money to states in 2008, South Carolina Governor Mark Sanford took a hard line position against accepting any federal stimulus funds. South Carolina's history of rejecting federal involvement, in what is viewed as a state issue, is no surprise considering its long history of anti-federalist sentiments and strongly held belief in state autonomy. Regarding education, school choice reform in K-12 and the hope of creating a board of regents for South Carolina were on the mind of Governor Sanford. Known for having a contentious relationship with the General Assembly, Sanford was unable to initiate educational change in the state. Thus, early in the Race to the Top application process, the South Carolina Department of Education's bid for RTTT funds faced an uphill battle. Superintendent of Schools, Dr. Jim Rex, had to convince the Governor to sign off on the RTTT application, which he ultimately did. While South Carolina would not see success in round one or round two of grant awards, a change in governor and in the superintendent position in 2011 created a shift in the state's position on RTTT. The new administration would take a firm stand against seeking out any RTTT funds in round three. The South Carolina case illustrates how a higher education system's governance structure and absence of multi-lateral relationships can be detrimental to innovation and how the lack of network connections can create further disengagement in funding opportunities for STEM innovations.

This chapter comprises three sections. The first section summarizes the governmental and educational structures in South Carolina and reviews the events already in play prior to the 2007 recession. The second section outlines a narrative chronology, highlighting seminal events or actors, of the STEM innovations that were included in the Race to the Top application and STEM initiatives underway outside the context of the Race to the Top work. This section relies heavily on interview data, which are presented in large segments at times, and archival documents for background and corroboration of interview data. The final section presents an analysis of the South Carolina case by utilizing the six dimensions of the analytic framework drawn from two diffusion theories and institutional theory.

Overview of State Context

Governmental Structure

In this section, I describe briefly the governmental structure in South Carolina including a description of the executive and legislative branches, their leaders, and composition of the membership of the general assembly. A description of the formal powers and characteristics of the executive and legislative branches provides context for a greater understanding of the environmental influences that may play a role in the state's actions around STEM innovations arising during a period of economic recession.

Mark Sanford, a Republican, served as Governor for the state of South Carolina from January 2003 until January 2011. Before serving as governor, Sanford spent six years in the U.S. House of Representatives. The popular press often described Sanford's relationship with the South Carolina General Assembly as contentious at best. In 2009, for example, he sued the General Assembly to prevent it from spending federal stimulus money in the state budget, which the state Supreme Court later ruled he had to accept (The State, 2010). Furthermore, in 2009, he

faced impeachment due to alleged ethics violations, which the General Assembly ultimately dropped in favor of censure. A proponent of limited government, Governor Sanford's education agenda included the issuance of vouchers for school choice options and a tax credit system for parents sending their children to private schools, both failed. In regards to higher education, Governor Sanford attempted to create a university system board of regents, which also failed. In the process, however, he was able to reduce tuition rates by tying new construction projects to caps on tuition hikes (The State, 2010). Nikki Haley took office as Governor in 2011. A Republican, Governor Haley served in the state House of Representatives from 2004-2011. During this time, the media viewed her as a strong ally of Governor Sanford and as someone who closely aligned herself with Sanford's political agenda. As such, in her bid for the Governor's office, Haley campaigned on a similar platform as Sanford's, promoting small government, school choice, and tighter budget limits.

The governor's appointment powers in South Carolina are considered weak in comparison to other states with the governor only appointing 13 agency/cabinet-level officials and direct appointments to only 12 board/commission positions. In South Carolina, ten other statewide officers are elected. Overall personal and institutional power of the governor is the lowest among the three states in this study with a 6.5 score on a 10 point scale and the average at 7.4 nationally (Beyle & Ferguson, 2007). The South Carolina Governor must share a wide range of state fiscal and administrative functions with the State Budget and Control Board, which has oversight for 14 organizational units and serves as the central management function for most state agencies. The size of the governor's legislative staff is more than Tennessee, but less than Georgia (Squire & Hamm, 2005).

South Carolina's General Assembly has 2.7 house members for every senator (Squire & Hamm, 2005). Members in the House serve two-year terms and members of the senate serve four-year terms. As noted earlier, legislative professionalism is a measure of internal determinants that may affect the policy making process (Squires, 2007). South Carolina ranks 36th in terms of legislative professionalization, which is below the median of all states (Squire, 2007). House and senate members have year-round personal staff at both the capitol and in their district, as well as professional and clerical staff support. In 2007, South Carolina had 26 Republican Senators and 20 Democratic Senators (CSG, 2007). At the same time in the House, there were 73 Republicans and 51 Democrats. At the time of the Race to the Top grant application, there had been little change in party control in both houses (27/19 in the Senate and 71/52 in the House) (CSG, 2009). In 2011, this trend continued as the Senate lost a Republican and the House Republicans grew to 76 (CSG, 2011).

Higher education structure

Established in 1967, the Commission on Higher Education is the statutory coordinating agency for higher education. South Carolina's Commission for Higher Education (CHE) is a coordinating board with consolidated budget authority over all 17 public institutions in the state. The commission consists of 14 members appointed by the governor with the consent of the General Assembly. The agency has a dual role in providing oversight for higher education on behalf of the General Assembly and in advocating for higher education institutions. The major functions of CHE can be categorized into four areas: advocacy and coordination, accountability, administration, and information services. As outlined in South Carolina's Code of Law, as amended, §59-103-10-5:

The membership must consist of one at-large member to serve as chairman, one representative from each of the six congressional districts, three members appointed from

the State at-large, three representatives of the public colleges and universities, and one representative of the independent colleges and universities of South Carolina.

Terms of office are four years with no more than two consecutive terms allowed, the exception is representatives from the public colleges and universities and independent colleges, who serve two-year terms. The representatives from higher education institutions are ex-officio members as well. The members of the Commission appoint the executive officer (McGuiness, 1988). The CHE has some authority, but their authority is not as strong relative to the individual college presidents. As such, state leaders explained that input received from the Commission or from an individual institution is not perceived as representing the will of the entire body of the system of higher education. From 2007 to January 2012, Dr. Garrison Walters served as the executive director of the CHE. Dr. Walters had previous experience as the Vice Chancellor for Academic Affairs and Economic Development and Interim Chancellor at the State of Ohio Board of Regents. In South Carolina, he served on the South Carolina Centers of Economic Excellence Review Panel, including three years as chair (CHE, 2007). The acting interim director since that time has been Dr. Julie Carullo, CHE's former chief academic affairs officer.

The South Carolina State Board for Technical and Comprehensive Education operates the Technical College System. The System is comprised of 16 technical colleges and two affiliate programs – the Center for Accelerated Technology Training ReadySC program and the Apprenticeship Carolina program. The ReadySC program is the development division for the Technical College System, which views the program as a key component of the state's industrial recruiting efforts. The primary task of the program is to recruit and develop pre-employment training programs for new industries in the state. The Technical College System, which has its own separate board, does have a more centrally located power base than the Commission for Higher Education. The board is comprised of twelve members, one from each congressional

district, two at-large members, and the South Carolina Superintendent of Education and South Carolina Secretary of Commerce as ex-officio members. The President of the Technical College System also serves as the Executive Director of the Board (South Carolina Code of Laws §59-53-20). The Board reports directly to the Governor, Budget and Control Board, and General Assembly. There is one community college, Spartanburg Community College, which has three branch campuses, but the technical college system governs the institution. Barry Russell served as president of the System from 2006 until 2010. The current president is Dr. Darrel Statt. Appointed in 2010, Dr. Statt previously served as the president of Central Virginia Community College.

Among public universities, the University of South Carolina, Columbia (USC) is the state's flagship research university and has four regional campuses. The University of South Carolina does offer two-year degree programs at its four regional campuses. Through the Palmetto Program, students at the regional campuses can complete a select number of four-year and graduate degrees through distance learning courses hosted by the main campus. There are 33 public universities/colleges in the state, three of which are research universities: USC, Clemson, and the Medical University of South Carolina (MUSC).

South Carolina Independent Colleges and Universities, Inc. (SICICUA) was chartered in 1953 and has 20 independent colleges and universities in its membership. The SICICUA is a member of the Council of Independent Colleges and the National Association of Independent Colleges and Universities. Of these members, Furman, Winthrop, Claflin, and Francis Marion University are collaborators with the three state research universities on South Carolina's EPSCoR/IDeA Networks of Biomedical Research Excellence (INBRE) program (described more fully later in this chapter). Only Furman and Voorhees College collaborated on the 2009 South

Carolina Research Infrastructure Improvement Program (funded through the NSF), which sought to build an alliance of institutions in the field of tissue biofabrication.

K-12 education responsibility and accountability is very dispersed in the State of South Carolina. The superintendent of schools is a constitutionally elected position. The State Board of Education is comprised of 17 members, one appointed from each of the state's 16 judicial circuits by the legislative delegations from those circuits and one member appointed by the governor. Members serve four-year terms. At the time that the Race to the Top application was initially pursued, Dr. Jim Rex held the position of superintendent. His successor was Dr. Mitch Zais, who previously served as president of Newbury College. Furthermore, Dr. Zais was a board member of the South Carolina Commission for Higher Education for several years prior to his election as the superintendent of schools.

Narrative History of Events and Policy Actors

This section provides a narrative chronology of how STEM innovations came to be on the state governing board's agenda. In South Carolina, the legislature took steps prior to the RTTT grant application to develop a strategic plan for higher education that includes STEM components. The absence of funding, however, has meant that individual institutional efforts largely comprise the work done in STEM (which involves both public and private institutions). As a result, federal funds towards STEM related research go directly to institutions, with little state involvement. Before describing the seminal events and actors, this section first provides the background of what was occurring in South Carolina prior to Race to the Top grant application.

Statewide STEM initiatives before 2007

Perhaps the most influential STEM initiative in South Carolina has been the SmartState program, formerly referred to as the Endowed Chairs or Centers of Economic Excellence

Program. The program began in fiscal year 2003. The Program is unique in that it is funded through the South Carolina Education Lottery, which must be matched dollar-for-dollar with non-state investment. However, the legislature eliminated funding in fiscal year 2009 and since then the program has operated off interest revenue. The program has five main objectives: 1) to recruit national and international leaders in science and engineering to work at research universities; 2) to expand graduate programs in STEM; 3) to assist in the recruitment of top tier STEM students; and 4) create STEM innovations that can lead to technology transfer and commercialization. The CHE reports that this approach has led to the creation of 7,000 jobs to date (CHE, 2012). As one higher education official described the program:

And this is a program of endowed chairs that the legislature has funded and that continues. We have 49 chairs. I think 38 of them are filled right now, and these are . . . this is a program to bring . . . try . . . or try to bring in some of the best and brightest researchers in the nation . . . the world to South Carolina in the areas of . . . in STEM research areas.

Since the state is not recognized nationally for having a strong STEM focus, higher education officials reported that institutions would have even greater difficulty recruiting if it were not for the SmartState program. Skepticism about the ability to recruit top-notch researchers is illustrated through a comment made by a higher education official:

So . . . we started a new branch of the medical school in South Carolina and much of the . . . much of the argument for it was, in addition to training more physicians, was that there would be a lot of biomedical research firms going into building a site in Greenville. And I just have to be very, very skeptical of that because attracting an M.D. to someplace like Greenville is one thing because the quality of life is, you know, very good, and the facilities are great. Attracting a really first-rate Ph.D. there—who knows that he or she's, you know, career is going to depend on getting grants when they don't have world-class graduate students and so on—it's a different issue.

The endowed chairs program exists at the three research universities exclusively, but other institutions benefit through support from CHE through the Centers for Economic Excellence. The Center of Excellence, for example, works with the CHE on fostering STEM

education initiatives at the institutional level. In 2010, the Commission approved The Citadel to work on a STEM education program focused on teacher preparation. The goal of the STEM Center at The Citadel is to provide graduate-level teacher training, K-20 teacher development opportunities, as well as student experiences, particularly in the coastal area of South Carolina (The Citadel, 2010). Funding for the program comes from Boeing, Google, and The Citadel Foundation – not from CHE or the state.

The SmartState Program was the catalyst to other pieces of STEM legislation. First, the General Assembly approved for South Carolina to participate in the Research Infrastructure Grant Program (Act 187 of 2004), which allows the three research universities to apply for EPSCoR/IDeA grants (IDeA stands for Institutional Development Awards). EPSCoR is a federal-state-university partnership that supports science and technology based research and economic development and uses state funds to meet federally required cost-matching commitments (CHE, 2012).

As an EPSCoR state, South Carolina is able to apply for funds as part of a group of states that have traditionally not received high levels of federal funding. Selected in 1990, South Carolina is eligible for Department of Education (DOE), National Aeronautics and Space Administration (NASA), Department of Defense, and National Science Foundation (NSF) funding to improve the research infrastructure in the state. In 2012, Governor Haley vetoed \$161,314 in recurring funds for the SC EPSCoR program. Governor Haley stated the veto was because she had vetoed the legislation in the previous fiscal year, which the General Assembly sustained, and this decision had no consequence to the college or universities' ability to attract sponsored research (The State, 2012). In spite of Governor Haley's position, however, the General Assembly overturned the 2012 veto.

South Carolina received funding through the IDeA program and the state developed two initiatives in the biomedical field: the IDeA Networks of Biomedical Research Excellence (INBRE) program (funded through the National Center for Research Resources) and the Centers of Biomedical Research Excellence (COBRE) program (funded through the NIH.) The INBRE program consists of 10 member institutions within the state. The goal of INBRE is to increase NIH funding within the state, including recruitment of faculty to the three research universities: Clemson, USC, and MUSC who then provide mentoring to the additional seven member institutions (SC INBRE, 2012). At the COBRE sites, NIH-funded investigators, who share similar backgrounds and expertise, work collaboratively with junior investigators on research projects.

The Research Infrastructure Grant Program sponsored by the NSF provides funding to enhance cyber connectivity within an EPSCoR jurisdiction in the hope of building institutional partnerships in STEM research. In 2010, the South Carolina Research Authority applied for ARRA funding through this particular NSF program. The institutions involved in the grant include three HBCUs (South Carolina State University, Claflin University, and Benedict College), USC Beaufort, and the Edisto Research and Education Center (NSF, 2010). In the NSF proposal, the institutions mention that the intent is to build upon the South Carolina's Light Rail Initiative.

The second piece of legislation arising from the SmartState program was the Light Rail Fiber Network (Act 330 of 2008) (CHE, 2009). The light rail is a fiber optic network linking the MUSC, Clemson, and USC and is built upon the existing fiber optic network, which extends between Atlanta and Charlotte. The third piece of legislation, the Venture Capital Investment Act (Act 187 of 2004), created two funds within the Department of Commerce which provide

capital to South Carolina-based firms looking to expand or restructure or small grants in support of research and technology transfer from one of the state's research universities.

In addition to the state-level programmatic and research initiatives driving STEM innovations, there are also funding mechanisms that play an important role in directing the work of institutions in STEM. For example, the South Carolina Code of Law states how the CHE will evaluate institutions in order to receive state funds - one of the criteria is research funding (Section 59-103-30). This performance based funding model, which started in 1999, is structured around institutional achievement of standards that developed by the Commission in consultation with the Council of Presidents (SC Code, § 59-103-45).

Besides research institutions applying for federal stimulus funds through federal agencies like the NSF, economic stimulus funds have also gone to support STEM innovations within the Technical College System. The SC Technical College FY 2011 Report (2011) described the South Carolina Office of Economic Opportunity Weatherization Assistance Program. The program funded technical colleges to offer training programs at seven "Energy Efficiency Training Centers" located on their campuses.

Involvement of higher education in STEM

STEM partnerships between higher education institutions and K-12 were rarely cited in the interviews with state leaders. Two exceptions are the Project Lead the Way program, which is a national program that was adopted by the USC engineering and biomedical schools. The program provides STEM education programming in middle and high schools with higher education faculty designing the curriculum in partnership public school teachers. The program also provides scholarships and admissions preference to students who graduate from schools participating in the program because courses are designed for students to earn college credit.

A second collaborative effort is underway to connect the Governor's School for STEM with postsecondary institutions. The initiative is similar to the Project Lead the Way program in that it is a dual-enrollment program where students earn college credit before they enroll. It differs, however, in that the Governor's School is a residential high school located in Hartsville, SC (one of only 12 in the country) solely focused on STEM. Publicly funded, the high school does receive grant funding from industry partners for classroom technology, financial aid, and program outreach and summer programs (SC GSSM, 2012). One education official described how the primary initiative of the program came out of community efforts and interest with no involvement by the state:

As far as other initiatives, you know, the Governor's School for Science and Math is probably the newest initiative, and it's one that they're doing on their own pretty much. They're . . . it's not being grant-funded or pushed by grants or outside money on that. They hope to get some, of course, but that's not what's pushing it right now, and it is a pretty good partnership.

South Carolina also invested in several scholarship programs for students majoring in STEM fields. Initiated by the Speaker of the House and then passed by the General Assembly in 2007, the Palmetto Fellow Scholarship is for students majoring in a STEM field. As sophomores, students can apply for an enhancement grant of about \$2,500 if they major in areas of science, technology, engineering and math.

Legislative Efforts

Two pieces of legislation form the foundation of the state's recent efforts to coordinate STEM reform in K-12 and innovation in higher education. First, the South Carolina Education and Economic Development Act (EEDA) passed in 2005 and also referred to as Personal Pathways to Success, is the K-12 education reform initiative for the state. The EEDA brings together the Department of Education, the Commission on Higher Education, the Department of

Employment and Workforce, the state Department of Commerce, and the South Carolina Technical College System to increase high school graduation rates as well as better prepare students for entry into postsecondary institutions. This is accomplished through programs that provide career awareness and exploration as well as individual graduation plans that align student aspirations with educational strategies. The legislation created better articulation agreements between high schools and postsecondary institutions and improved the academic readiness of high school graduates to enter postsecondary education. The Pathways program builds upon the academic core requirements in high school by requiring all students to declare a career major through a course of study in one of 16 career clusters. Schools also collaborate with local businesses to provide internship experiences in their chosen career major. As one education official describes:

[The] EEDA initiative that came into the state about 2005, and it was a way to look at starting to transform our high schools, and it was modeled after the cluster curriculums. They identified different areas and started individual graduation plans for students beginning in the eighth grade to engage them in areas of interest, and so naturally, there were clusters in the sciences and health areas and which have been pretty popular with students.

The EEDA also created twelve regional education centers, which provide a virtual support center for students and adults who need career guidance. Each center has an advisory board comprised of a school district superintendent, high school principal, the local workforce investment board chair, a technical college president, a four-year college or university representative, a career center or school district career coordinator, a parent-teach organization representative, and local business and civic leaders (SC Pathways, 2012).

While the CHE has a limited role in promoting STEM innovations among its institutions, South Carolina's General Assembly took action to develop a strategic plan for higher education that has a large focus on fostering STEM innovations in the state. In 2007, the General

Assembly authorized the Higher Education Study Committee (HESC) with the passage of Proviso 5A.28 in the FY 2007-08 Appropriations Act. The HESC includes nine members, appointed by the Governor, the President Pro Tempore of the Senate, the Speaker of the House of Representatives, and the chairs of the Senate and House finance and education committees (CHE, 2009). The General Assembly authorized HESC to develop and recommend a multi-year plan for higher education in South Carolina to meet the needs of the state. The final report, issued in March 2008 and titled, *Leveraging Higher Education for a Stronger South Carolina*, identifies four goals that HESC later developed into a recommended action plan for higher education. The goals include: 1) making South Carolina one of the most educated states; 2) increasing research and innovation in South Carolina; 3) increasing workforce training and educational services; and 4) realizing South Carolina's potential, resources and effectiveness. After the initial report was released, HESC established a working group for each goal. These working groups met during fall 2008, tasked with developing recommendations to the HESC for the implementation details and necessary resources to accomplish the assigned goal.

In 2008, with the inclusion of the Proviso 6.27 in the FY 2008-09 Appropriations Act, the General Assembly reauthorized the HESC to continue its work. Based on the recommendation of each working group, HESC developed an implementation plan, which included among other things, a specific initiative for CHE: "Enhance research and innovation partnerships among all colleges and universities and among colleges, universities and the private sector" (SC Commission, 2009, p.3). Higher education officials reported, however, that CHE has yet to identify specific STEM innovations to address this goal (CHE, 2011).

Specifically, the HESC Action Plan for Higher Education lists four specific objectives which speak to the importance of developing research and innovation in South Carolina: 1)

create a culture of discovery; 2) optimize the process of technology transfer; 3) enhance research and innovation partnerships among all colleges and universities and among colleges, universities, and the private sector; and 4) recruit and retain the brightest innovators (HESC, 2009, p. 30-38). Specific recommendations under each goal range from partnerships with industry, regulatory relief to enhance innovation and promote research, increasing the numbers of STEM teachers, integrating entrepreneurship into curricula, and specific programs to engage undergraduates in research.

Connections between the HESC Action Plan and the SmartState Program are also evident. For example, The HESC Implementation Plan (2009) highlights the need for a second round of bonds under the grant program in order to expand research facilities and the need to provide funding to complete the SC Light Rail project so that all higher education institutions are linked (p. 34).

A higher education official stated that the difficulty in CHE moving forward with the State Action Plan for Higher Education, however, is due to lack of financial support by the state. As one higher education official reported:

A number of those focused on increase in areas in the STEM disciplines. So, the ability to be able to focus on those and work on any in a concerted way has really been restricted for the most part by funding and resource needs and not being able to focus on those right now...

Rise of the Race to the Top Grant Application

In 2009, the Obama administration made available economic stimulus funds to states in order to offset state budget shortfalls. Governor Mark Sanford was the first governor to reject some of the stimulus funds, approximately \$700 million out of a \$7 billion package, claiming it would harm his state in the end. Sanford, who was serving as the Republican Governors Association chair at the time, stated that federal stimulus money would lead to an increase in the

federal debt and create expectations for the state to participate in government programs that the state would later have to pay for (Wall Street Journal, 2009). As Governor Sanford explained in his editorial article to the Wall Street Journal (2009):

Here's the background: Before the stimulus bill passed, I asked for states not to be bailed out. After it was signed into law, I said that a state bailout would create more problems than it solved, and that we shouldn't spend money we don't have. That debate was lost, so I looked for a reasonable middle ground. I asked the president for his support in using the \$700 million to pay down state debt.

If we're going to spend money we don't have at the federal level, it becomes all the more important that our state balance sheet is in good order -- particularly if this is a protracted downturn. But many people do not realize that the stimulus money runs out in 24 months -- at which point South Carolina will be forced to find a new source of funding to sustain the new level of spending, or to make sharp cuts...Last week I reached out to the president, asking for a federal waiver from restrictions on stimulus money... the White House declined my request for a waiver yesterday afternoon.

The move also created dissention among members of the General Assembly, who later sued the Governor in order to force him to accept the stimulus funds. Ultimately, the State's Supreme Court ruled that Governor Sanford had to accept the funds. The Governor's stance against stimulus funding understandably created a difficult environment for a proposal that sought out federal funding. So, as the RTTT application details were publicized in 2009, a government official reported that Dr. Rex had an uphill battle ahead of him.

Jim Rex, who was the superintendent of education at the time—he was a Democrat—again, popularly elected by the public—came over and asked Governor Sanford, you know, a Republican, obviously—whom I worked for—if he would sign off on this and, you know, this follows kind of . . . I don't know if you're aware of this—the state was debating the first round of stimulus and whether or not we would just take money and put it into, you know, kind of the . . . what the General Assembly wanted, or would we take it and make some changes in our state structure of government and all like that. So, we had this long standoff about this at that point in time, and Gov . . . Dr. Rex came over at the tail end of that.

From our administration's standpoint (it) wasn't one that we're just going to automatically sign off on several funds, particularly when there's a, you know, a definite period of time that those federal funds would be available, and with this there is. I mean,

you know, this kind of gets you started, but eventually you're going to have to figure out how to fund this from the state level on your own.

The only part that he [Governor Stanford] really kind of opposed was the idea that we would just take a few hundred million bucks, put it in our budget for one year and then . . . or a year and a half, two years, and then you're stuck with this billion dollar hole at the end of the two years, which is what we had last year. So, that was really the only . . . only problem with that.

In explaining why South Carolina ultimately decided to apply for the first round of funding, a former government official stated:

We found a lot of common ground there. You know—expansion of charter schools, the idea of getting good principals and leaders and teachers into low-performing/under-performing schools and, you know, Title I areas and things like that. That . . . those were goals that Governor Sanford had laid out when he first ran for office back in 2002.

Ultimately, South Carolina's Department of Education did submit a RTTT application in the first round. While South Carolina was one of 15 finalists in the first round, the state still needed to send a five-person team to Washington the week of March 15 to make a presentation and answer questions from a panel of judges. Superintendent of Schools, Dr. Rex commented about the precarious financial situation in the state at that time that would play a factor in the final decision:

In a head-to-head competition with 41 other states, these independent judges found that South Carolina has the potential to be a school improvement leader in the 21st Century. It's ironic that at the same time, our General Assembly is discussing extraordinary budget cuts that could take us back to the 20th Century (The State, 2010).

When the DOE did not select South Carolina during the first round of funding for RTTT, the South Carolina Department of Education went back through the application to make suggested changes so the U.S. Department of Education would consider South Carolina for funding in the second round. In September 2010, the state learned it did not receive funding in the second round and considered applying in a third round, but the new Superintendent of Schools, Dr. Zais, took the position that the state would not pursue RTTT funds any longer:

The Race to the Top program expands the federal role in education by offering pieces of silver in exchange for strings attached to Washington. More federal money for education will not solve our problems. Schools need less, not more, federal intrusion to increase student achievement (The State, 2011).

An education official re-emphasizes the administration's concerns about financing long-term initiatives found in the RTTT application. As the official stated:

In terms of driving change, one of our concerns was that ultimately the money's not going out to the front lines as much as it would be used to hire consultants and build out programs that then the state would have to sustain with new state money that would we'd have to find. And so, when you look at round three, I believe that our state would have been eligible for about \$12 million if we could have competed. But, the fact is that our state was not eligible to compete because one threshold requirement was that the state ... had to meet the requirements for spending levels on education and higher ed and K-12 and we didn't meet that threshold...

In addition to the lack of state funding support for education, there are several indications that a lack of collaboration between CHE and the Department of Education on the RTTT grant may have also played a role in the state's unsuccessful bid for RTTT funding. As one higher education official described:

There was not a particularly good relationship with the Department of Education. I mean it was a functional working relationship, but it was not one where the Department of Education encouraged higher education participation at a fundamental stage of policy development.

A former government official emphasized the lack of coordination likely was a factor that contributed to the state's unsuccessful bid for RTTT funds:

What would have made us probably ultimately more successful is if we did have a higher ed board like a Board of Regents that had a little bit more authority to coordinate amongst the various schools. You know, that . . . that's a . . . that has to probably be considered a weakness, because I frankly can't remember two months of their involvement in really crafting a part of that application.

Officials at the Department of Education acknowledge that the agency largely drove the drafting of the RTTT grant. An education official supported this position:

[Commission for Higher Education was] consulted, after the fact, about the application as things went on, but the decision to apply for that was very much a state Department of Education [decision].

The CHE also did not have its own initiatives underway to guide institutions in STEM innovations that could have been included in the RTTT application. As one higher education official states, the South Carolina Commission for Higher Education “had very little tradition of going after grants, very little tradition of leading major initiatives.” CHE officials reported frustration with the environmental conditions in South Carolina, which made it difficult to focus on STEM innovations. For example, the CHE’s executive director Garrison Walters proposed the idea of funding 20 graduate student stipends per year for a total cost of \$200,000 with the option for students to receive the funds for up to four years (Walters, 2008). The General Assembly never approved funding for this initiative. Instead, the Commission’s time and focus was spent on making the case for why a postsecondary degree is important so that the General Assembly would appropriate needed funds for higher education. As one higher education official described further:

And, again, that’s by contrast to Ohio where [the SHEEO] got the NSF grant at a time when the state was undergoing a severe recession and the need to match the grant was a big challenge for an incoming moderately, conservative Governor, but they did it. And the state . . . that state has continued to very actively support STEM initiatives. And there just isn’t that kind of consensus in South Carolina.

In Ohio, the higher education governing board has authority over more than \$20 million a year—a lot more than that in today’s dollars—in matching incentive grants for research and there are no such funds of any kind in South Carolina.

South Carolina’s rejection of federal financial assistance through Race to the Top funds was not because the state was better off financially than other states – in fact in many ways it was worse. South Carolina had the second highest unemployment rate (10.4%) in the country at this time (USA Today, 2009). While the state ended up accepting the federal stimulus funds,

there was little effect on higher education or STEM innovations for the long-term. As one higher education official described the state of funding for higher education in South Carolina immediately after the recession:

Colleges—starting in 2008—we had some of the largest cuts. And in this state those cuts reached about 50% of their base budgets. So, you can see that that was pretty significant decline for the institutions. So, the stimulus money that was provided to them—they, of course, had to use it for one-time purposes. Some of that they used related to maintenance and renovation for buildings, since it was one-time funds, but other was just to kind of fill that gap related to the one-time need that that money was available for their education and general purposes. So, there weren't any specific . . . it was really just directed to the institutions, and they decided how to use it. There was no specific initiative within higher education that those monies were used for.

When looking at appropriations per FTE for fiscal year 2006-2011, South Carolina ranked dead last with a 31.8% decline in funding during this timeframe and was last in total educational revenue per FTE from 2006-2011 with an 18.7% decline (SHEEO, 2012).

Making the Case for Higher Education in South Carolina

While the state did not receive RTTT funds or had much on the CHE agenda regarding STEM innovations, higher education officials stated that their focus was and continues to be on convincing the public and General Assembly about the importance of a college degree and in advocating for more financial support for higher education initiatives. The HESC Action Plan placed great emphasis on the need to appropriately fund higher education institutions in the state in order to achieve economic and educational goals. In making its point, the HESC specifically referenced cost per student in three states: Kentucky, Georgia, and North Carolina and the report makes the case that South Carolina ranks 15 out of the 16 SREB member states in funding per student (HESC, 2009). While the state does provide scholarship support for higher education, the General Assembly and Governor's Office have yet to support any substantial financial investment in operating funds for institutions or in capital funding. Again, the HESC Action

Plan pointed out that compared to regional neighbors, South Carolina trails behind North Carolina and Georgia - with North Carolina's total funding 80% higher and Georgia's funding 62% higher than South Carolina's (HESC, 2009).

Higher education officials explained that most state-level STEM initiatives have lacked financial support to get them off the ground since 2007, so only independently funded or institutionally driven initiatives have continued. Specific industries within the state like Boeing, BMW, and tire manufacturing turn to higher education and local officials to ask how they can get more STEM graduates, but lack of funding for STEM innovations is driving companies to partner with institutions on an individual level. For example, USC is looking at an aerospace engineering program in order to meet workforce needs at Boeing. And one higher education official reports that Clemson University has developed an automobile and transportation engineering program based on BMW's presence in the area. As one higher education official described how the financial barriers have limited what the CHE can do in STEM:

Funding has been . . . for the, you know, certainly for the last four years, probably for the last five, has stood in the way of almost everything here as far as initiatives. The fact that things like the enhancements have . . . the scholarship enhancements for students in STEM disciplines . . . majoring in STEM disciplines . . . that those have carried on I think is the fact that they are lottery funded as opposed to general fund funded has made that possible.

In support of the state's biomedical research focus, examples of private-public partnerships in STEM can be found in the health care initiatives within South Carolina. Health Sciences South Carolina is statewide consortium that includes Clemson University, Greenville Hospital System University Medical Center, Palmetto Health, the Medical University of South Carolina, the University of South Carolina and Spartanburg Regional Healthcare System. The mission of this group is to improve the health and economic well-being of the state through a coordinated strategy to advance research and education. Launched in 2004, the partnership is a

statewide biomedical research collaborative that is able to leverage the network partners to be more successful in applying for federal research funding (HSSC, 2012), while also supporting the SmartState initiative. While an important STEM collaboration between higher education institutions and industry, these initiatives were well underway before the economic recession.

Case Analysis

With the chronological narrative outlined, this section analyses the influences and events of the South Carolina case against the six dimensions of the analytic framework. (See appendix D for a summary chart of the framework.) The central question of this study is to examine how STEM innovations come to be on the state higher education agency agenda. This study uses diffusion models to identify conditions that drive the spread of new policy ideas. As previously described, diffusion models explain how members of a particular professional or social system communicate about innovations through informal and formal channels over time (Berry & Berry, 2007). In the case of South Carolina, the state was selected as a “non adopter” to examine what influences might be absent compared with neighboring states that were successful in their bid for RTTT funding and in implementing additional STEM innovations after 2007.

Network Pressures That Influenced STEM Innovations

While the RTTT grant application for South Carolina mentions several national initiatives that it would have been incorporated into the state’s work around STEM if South Carolina had received funds, little mention of these same national programs were brought up in the interviews or in other document searches. As such, it appears that the South Carolina RTTT application emulates best practices nationally, but the state was largely un-invested in these initiatives prior to the application. The exception is the influence of federal research funding that is connecting specific institutions within the state to federal agencies. This is evidenced through

the state's classification as an EPSCoR state and the various grant programs that its research universities are working on through NSF and NIH funded programs like the Research Infrastructure Grant Program, Venture Capital Investment Act, and NSF funding for initiatives with the Technical College system. In the document search on STEM innovations, however, there is a lack of evidence that any STEM innovations came about after the economic recession and none of the interviewees in this study could cite any new STEM initiatives on a state level that have been created since 2007.

The report by the HESC, which lays out a plan for STEM innovations in the state, is one step that the state has taken to identify strategies to enhance its higher education system, specifically in the area of STEM. The document references national best practices in STEM and pulls references from a cross-section of states in the country. As interviewees cited, however, lack of state funding has left much of the objectives in the document untouched. The initiatives that are underway either required no funding or were initiatives already funded through federal grants and public-private partnerships.

Another unique distinction for South Carolina is the absence of policy leaders within a greater network who are advocating for STEM innovations. The national interaction model assumes that as the frequency of interactions among professionals and state officials within certain networks increases, the more likely those states are to adopt similar policies based on interactions with these members (Berry, 1994). In the case of South Carolina, none of the documents or interviews reveal the presence of networking among policy actors either between state agency heads or government officials and national non-profits. The lack of networking may be one reason why the state is not sought after by these external funding partners – because they are not viewed as connecting to the national reform movements.

Influence of RTTT Incentives on STEM Innovations

The RTTT competition is a federal grant intended to influence the educational reform efforts within the state by offering financial incentives during a period of economic recession. The competitive preference area within the RTTT grant centered around STEM and states who received funds are part of a larger national reform effort in these areas – showing isomorphism in the adoption of STEM innovations that illustrate the national interaction model. South Carolina took a unique approach in rejecting federal stimulus funding from an early stage and thereby rejecting federal influence on education reform. Later, this position translated into the state's inability to secure assistance through RTTT funds or from other non-profit agencies for state education reform. Evidence of the anti-federalist sentiments of South Carolina politicians can be seen in other initiatives outside of education. As one education official described:

For example, Governor Sanford refused to participate in the change in the way driver's license information was organized and exchanged so that it will function across states. There was a federal requirement to do that after 2001, and South Carolina almost—it came right to the last minute—did not meet the federal standards and which would have meant that South Carolina . . . holders of South Carolina driver's licenses couldn't fly on U.S. airlines. The Governor felt that strongly that that was a federal overreach and he ended up waiting until the very last minute before he finally gave in and let the changes occur.

There's a strong sense that, you know, outside interference is unwarranted and inappropriate. There's a belief that too much tax money is going to Washington, and it's going for things that are telling us what to do when we don't need to be told what to do.

The general unwillingness of South Carolina's political leaders to participate in national initiatives, particularly RTTT, meant that there were no new policy levers to move the state towards partnerships beyond what it was developing internally.

Influence of Regional Neighbors and Ideological Similarities

In the case of South Carolina, there is little evidence to suggest that regional influences played a role in advancing particular STEM initiatives. When asked what states were looked to

as examples of best practice related to STEM, only the SREB states of North Carolina, Florida, and Texas were mentioned by respondents. Mention of the influence of Ohio's STEM Network appeared in the interviews and in the document analysis, however. As a whole, there is a lack of concern over what other neighboring states are doing; a position taken by state leaders because of the need to increase enrollment and funding for higher education. As one higher education official stated:

We aren't . . . we aren't competing against the other states for . . . let's say for students. We're trying to provide the best we can for our citizens.

In fact, one higher education official stated that citing North Carolina as an example can sometimes be looked down upon. As one higher education official stated:

I used North Carolina as an example all the time, although I was often warned not to do that because people didn't like the kind of the ambitious comparisons. But my conclusion was that you have to . . . you have to show them something. You have to show them that back in the 1960s, the two Carolinas were pretty much in the same space and one invested heavily in higher education and one didn't. And the one that invested heavily has a vastly higher income than the one that didn't. . . Specifically about STEM? No, although in talking in general about the technology economy of the Raleigh-Durham area we certainly did that.

Since South Carolina officials felt the greater emphasis at this time was convincing state leaders that higher education needs additional state appropriations, most of the attention was comparing the appropriation per student to students in the states of Georgia, North Carolina, and Kentucky. Furthermore, in the 2012 CHE report to the Ways and Means Committee, Kentucky, Texas, North Carolina, and Virginia were cited as states investing more in higher education. As such, officials used these states as "regional pacesetters" related to education funding.

Perception of Competition with Neighboring States for Resources

Walker (1969) suggests that regional diffusion occurs as a result of perceived competition between institutions and between states for resources. During a period of economic recession,

one would expect to hear how financial constraints made the competition for resources even more fierce. In the case of South Carolina, however, the entire focus has been its low national ranking for state funding of higher education. This is a challenge that the state has faced for many years, but was only heightened when the unemployment rate for the state became the second highest in the nation. As such, a concerted effort by CHE officials was underway to illustrate how investment in higher education and in student educational attainment rates can turn the states' economic woes around. The challenge, of course, is working within a governmental framework where asking for federal assistance is perceived negatively. For many states, federal assistance through participation in national reform efforts has led to the procurement of additional resources through national non-profits. There is a national, rather than regional, focus on competing for financial resources to accomplish educational reform initiatives. South Carolina's position of not "chasing federal dollars" (particularly in RTTT) resulted in the state then looking unfavorably with other potential funders. Thus, the state is in a cyclical pattern of not moving forward with STEM innovations due to insufficient financial resources from both the state as well as national non-profits.

Institutionalization of STEM Initiatives

The RTTT grant application mentioned several national programs that would have further institutionalized particular STEM initiatives within the state. For example, South Carolina's RTTT application mentions UTeach and the program is something that other states incorporated into RTTT applications. At this time, however, South Carolina is not implementing the program.

While South Carolina did not receive RTTT funding, several pieces of legislation in the state have led to the institutionalization of STEM innovations. As mentioned earlier, institutionalization differs from diffusion in the emphasis on how rules or procedures are built to

support the legitimization of the innovation (Colyvas & Powell, 2006). Clearly, the Education and Economic Development Act (EEDA) is the primary piece of legislation that institutionalized career clusters in science and engineering and that led to the development of a state infrastructure to support STEM initiatives. The interesting twist behind the EEDA, however, is that it still gives local districts autonomy to make their own decisions when it comes to STEM as opposed to a state directive on how STEM education in K-12 should connect with higher education. While the state adopted the common core state standards for English Language Arts and Mathematics in July 2010, interviewees and the document search yielded little mention of these standards in relation to STEM preparation in postsecondary education.

The state's Palmetto Scholarship is another way in which the state is incentivizing student consideration of majoring in STEM. The merit-based financial aid programs represent a disproportionate amount of funding to assist students with obtaining a college degree. The CHE report to the Ways and Means Committee (2012) stated:

The current financial aid portfolio is not balanced - as of FY 12 merit programs (Palmetto Fellows, LIFE, SC HOPE) represent 70% (\$230 million) of approximately \$330 million in appropriated dollars for undergraduate scholarship and grant programs, whereas state need-based programs (CHE Need-based and Tuition Grants) represent 16% (\$53 million)...

The SmartState program provides a third example of how state leaders are institutionalizing certain STEM innovations in the state. The SmartState program led to the creation of additional provisions by the legislature to develop funding opportunities for institutions to enter public-private partnerships in STEM. This includes not only the funding opportunities that come out of the Infrastructure and Light Rail grants, but also in the work that the Centers for Excellence undertake in order to attract endowed chairs – which help to recruit graduate students, research grants, and industry partners.

Since there is little coordination from CHE, the unspoken understanding is that individual institutions should be taking on the work of implementing STEM innovations that will meet the needs of the state. As one former government official clarified:

You know, what we have in this state though is a situation where you've got really two or three schools that dominate the funding from the legislature and, you know, there's this push—particularly with those two or three schools—to be involved in quote/unquote economic development and, you know, we can debate whether or not that's a valid function of, you know, of a publicly-funded college or a university. But, at the end of the day, I think what is hard to debate is the fact that that's clearly impacting the . . . the courses that are being taught [and] in the education that's being provided at those schools because funding is going to quote/unquote economic development projects and some of it's good research, you know.

The performance based funding model in the state only reinforced the expectation that institutions engage in economic development and research. As written in the SC Code of Law § 59-103-30, one of the critical success factors used to measure performance of an institution, taking into account their mission, is the amount of public and private sector grants the institution received.

Involvement of the State Higher Education Agency in STEM Innovations

The primary question of this study is to examine how STEM innovations rise to the state's governing board agenda during a period of economic crisis. In the case of South Carolina, the CHE's involvement in STEM innovations is limited, if not, non-existent. Perhaps due to the state's higher education governance structure, CHE has little impact on STEM innovations occurring within the state. Political and education leaders have made the argument about the need to restructure, but ultimately efforts to do so have been unsuccessful. As one former government official describes the previous administration's view of CHE:

The Commission on Higher Education—while the people there are well intentioned and I believe truly want to do the right thing—is woefully inadequate in terms of coordinating higher education across the state. It . . . it does not . . . well, it is not effective in avoiding duplication. It is not effective in avoiding the creep of various universities on programs

that other universities have. Until South Carolina gets serious and either a) empowers the Commission on Higher Ed with true authority, or b)—and b is what I would suggest—create a Board of Regents like Georgia has and some other states, then we’re not going to do an adequate job in truly coordinating higher education.

Higher education officials have also noted their frustration with the inability to truly promote a statewide focus on STEM innovations across all institutions. As evidenced by the number of federal grants sponsored by one of the three research universities in the state, all higher education STEM efforts are directed by individual institutions. Multi-lateral collaborations did not occur within the state. CHE officials proposed several ideas, but universities generally did not take an interest.

The General Assembly implemented several incentives and statewide programs prior to the economic recession that continue to drive state-level innovations that tie to economic development goals. The CHE, however, is largely absent in the discussions surrounding these initiatives as individual institutions are seen as the major players in the public-private partnership. In the January 2012 report to the Ways and Means Committee, the SHEEO officer illustrated that the Higher Education Study Committee’s Action Plan of 2009 emphasized the need for the governance system to be revamped to give CHE a stronger role in coordinating higher education (SCHEC, 2012). As stated in the report to the Ways and Means Committee:

To ensure greater system coherence, effectiveness and efficiency in statewide planning, CHE working in close collaboration with a revitalized Council of Presidents should:

Use existing authority to provide the Governor, General Assembly, and public with an annual report that outlines recommendations, both statewide and by institution, on progress toward the goals of CHE’s Action Plan for Higher Education...

In this context, CHE would seek necessary regulatory revisions to enhance its coordinating authority but would not seek governing authority on any of these factors. To do so would conflict with the responsibility of institutional boards of trustees (p.14).

While the importance of fostering STEM innovations is on the forefront of the national discussion in education and certainly is on the minds of policy leaders in South Carolina, the current focus in South Carolina has been on demonstrating the importance of higher education. CHE officials must sell this message to two audiences: first, to the citizens of the state in order to increase the number of students working towards a postsecondary degree and second, to the General Assembly in order to increase the state's investment in higher education.

Conclusion

In the case of South Carolina, budget concerns and decreasing state appropriations for higher education took center stage after the economic recession. Regardless of the historical and current political opinions regarding federal incentives to participate in nationally driven reform efforts, the state's lack of coordination not only for higher education, but also between agencies meant that outside reform agencies did not view the state as favorably positioned for reform. As such, the state did not receive the assistance that other states received in writing their RTTT grant proposal and were unable to bring together the necessary partners to make a strong case for the RTTT grant. The result is that South Carolina fell further behind when it came to securing needed resources to implement the STEM reforms identified by the HESC.

CHAPTER SEVEN

CROSS-CASE ANALYSIS

The aim of this chapter is to describe the how STEM innovations rise to the state higher education agency agenda during a period of economic crisis. The two overarching research questions guiding this study aim to provide a descriptive understanding of the external influences that raise particular STEM innovations to the state policy agenda and to reveal conceptual implications. As formally stated in Chapter 1, the two research questions are:

1. How does STEM policy come to be on the state higher education governing board's agenda?
2. How do three theoretical models – national interaction, regional diffusion, and institutional theory explain STEM policy activity in the states?

The three theoretical frameworks present different perspectives on how innovations are adopted and gain acceptance by state leaders. To gauge the explanatory power of each framework, this study relies on an analytic framework of six dimensions as outlined in Chapter

3. Each of the three state case study chapters included a within-case analysis along these six dimensions. This chapter utilizes the same analytic framework to present between-case analysis.

The first section of this chapter uses cross-case analysis to explore the similarities and differences between cases along the six dimensions of the analytic framework. For each dimension of the analytic framework, the external influences for each state are summarized in table form, then considered more fully from the analysis of each state. As in the within-case

analysis reported in Chapters 4, 5, and 6, analysis in this section examines each dimension in the order outlined in Appendix D.

Network Pressures that Influenced STEM Innovations

As mentioned in the literature review in Chapter 3, diffusion research seeks to identify conditions that drive the spread of new policy ideas through certain channels over time among the members of a social system (Rogers, 2003). A state learns from others when state leaders borrow ideas from professional networks for implementation within their own state. As illustrated in Table 4 below, national networks like membership in the NGA, SREB, or in national education reform initiatives like the Common Core Standards or Complete College America program are examples of networks where state leaders shared best practices related to STEM innovations. The cross-case comparison of the national standards, networks, or organizational pressures that influenced STEM innovations reveals convergence around similar ideas with slight variations in the extent of the external influence based on the state's willingness and ability to participate in broader national programs. (The table below reflects only the areas where there was convergence, but a complete list can be found in Appendix D.) Each state episode includes evidence of the influence of national non-profits and federal government initiatives on the STEM innovations occurring within each state since 2007. Table 4 summarizes the network pressures influencing STEM innovations in the three states. The number in parenthesis indicates the number of individual interviewees who mentioned the agency or project or the number of specific archival documents that reference the agency or project.

Table 4. *Network Pressures That Influenced STEM Innovations.*

	South Carolina	Georgia	Tennessee
National Standards,	Total: 14	Total: 32	Total: 37

Networks, or Organizational Pressures which Influenced STEM Innovations	Examples: Common Core Standards (3) Gates and Lumina initiatives. (1) National Governors Association (1) EPSCoR state (1)	Examples: Funding from Gates Foundation (3) & Lumina (1) National Governors Association (3) UTeach (2) Common Core Standards (1) American Diploma Project (1) SREB (1) Complete College (1) Achieve (1)	Examples: Complete College (4) Funding from Gates Foundation (3) & Lumina (2) Achieve (2) EPSCoR state (2) UTeach (2) Common Core Standards (1)
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In South Carolina, state leaders emphasized work going on at the institutional level with federal research grants and participation in national and regional associations. For purposes of this study, South Carolina is viewed as a “non-adopter” since they did not secure RTTT funds and had limited involvement from their higher education governing agency in STEM innovations. Out of the three states in this study, South Carolina had the fewest number of network connections (14) reported by respondents (see Table 3 in Appendix D for more details). As such, the lack of federal grant support and funding from national non-profits compared with the other three states in this study limited South Carolina’s ability to participate in several national STEM reform initiatives. In spite of this lack of funding, however, South Carolina’s work in STEM is still influenced by other national education reform initiatives like the Common

Core Standards. Most of the emphasis in STEM innovations, however, is influenced by participation in federal NSF-sponsored grants like the Science and Mathematics Teacher imperative and projects resulting from funding as an EPSCoR state. In summary, the national interaction model explains how the NSF-sponsored grants and select national reform efforts like the Common Core Standards are influencing specific STEM innovations within the state – though not to the same extent as the other states in this study.

By far, Tennessee has the largest number of network connections identified in this study, with 37 network connections reported by respondents, which were also supported through the document analysis (see Table 3 in Appendix D for details). The influence of this participation is seen not only in Tennessee's early selection and participation in national educational reform projects, but in the particular connections made with Battelle and Achieve through common policy actors. Tennessee policy leaders cited an extensive list of associations with national non-profits and federal grant initiatives that would later influence the work outlined in the RTTT grant. The list of associations began with the Gates Foundation's initial interest and investment in Tennessee, which aligned them to Education First. Due to the momentum in Tennessee around education reform, the state became a leader regionally in STEM education reform and in STEM partnerships with federal research initiatives. The existing relationship with the Oak Ridge National Laboratory influenced the state's ability to work with Battelle on several federal research grants, as well as connected UTK with state-level STEM innovations. The participation of Tennessee with the work of ACHIEVE led the state to become an early adopter of the Common Core Standards. Early participation in the Diploma Project and Complete College America programs further guided the direction of STEM innovations taken within the state once Tennessee secured RTTT funding.

Tennessee was the only state to cite extensive partnership with the private research university within the state – Vanderbilt. The influence of having the 23rd nationally ranked research institution within the state provided additional organizational pressures that influenced STEM innovations. As a result, the complex interaction between various network connections in Tennessee is evidence of the national interaction model. The complexity and depth of the network connections is greatest in Tennessee compared to the other states in this study, which provides strength to the argument that as the number and frequency of network connections increases, the greater the external influence.

Georgia also had a significant number of network connections mentioned by respondents and further supported by evidence in the document analysis, with a total of 32 reported connections (see Table 3 in Appendix D for details). For Georgia, the intentional exclusion of external non-profit organizations from discussions regarding the formulation of the RTTT grant application meant that Georgia largely relied on the existing federal and state initiatives already underway in the state to guide its work. Similar to Tennessee, the Gates Foundation selected Georgia to receive funding for a consulting group to work on the RTTT grant. The difference, however, is that there is a lack of evidence to show network connections with the policy leaders to specific national reform programs. Instead, Georgia relied on its professional association membership in NGA and SREB, and the work of the Georgia Professional Standards Commission to learn of best practices worth replicating in the state. Similar to Tennessee and South Carolina, Georgia largely looked to connect its existing work funded by the NSF to the larger RTTT grant as a way to sustain and expand current program offerings. Thus, while Georgia shows some evidence of the national interaction model at work in directing STEM innovations, it is limited to programs the state was already participating in prior to 2007, like the

NSF-sponsored Mathematics and Science Partnership Program and only included new initiatives like the inclusion of UTeach because of its participation in professional conference opportunities. However, evidence does not exist to support the idea that national non-profits directly influenced the STEM innovations adopted in Georgia after 2007.

Influence of RTTT Incentives on STEM Innovations

Researchers have used the national interaction model to explain how time and issue topic influence the direction taken by states on policy innovation. Within this study, I included the influence of the federally funded RTTT grant application (which was part of the larger ARRA stimulus funding) in order to examine how RTTT incentives influenced state policy innovations around STEM. As can be expected, the three cases experienced differing levels of influence based on how successful they were in securing RTTT funding during each phase of awards. Table 5 illustrates examples of top responses for each state (with the number in parenthesis indicating the number of references from interviewees or found in documents.) While all three states sought out RTTT funds in round one, differences exist based on what the state chose to include in the application, the phase in which the state received RTTT funding, and internal determinants specific to the state that mitigated federal and national organization influences.

Table 5. Influence of RTTT Incentives on STEM Innovations.

	South Carolina	Georgia	Tennessee
Influence of RTTT incentives on STEM Innovations	Multi-lateral collaborations between institutions did not occur/institutions are working on their own (2)	Innovation Fund connected CEISMC/GA Tech to schools (3) Accelerated work already underway – PRISM and USG STEM Initiative (2)	Connected innovations going on within the state/ recruitment of STEM related industries (4) STEM Education Reform/Teacher Prep (2)

		UTeach (2)	Funding to accelerate initiatives already underway (2)
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For South Carolina, as a “non-adopter,” respondents cited new programs, which would have connected innovations going on across institutions within the state if the state had received funding. As indicated in Table 5, what policy leaders felt was absent from the policy process to make these goals a reality, however, was the lack of multi-lateral collaborations between institutions before the grant application was released and the lack of statewide guidance either from the General Assembly or the higher education coordinating agency in STEM innovation reform. Internally, the debate between the governor and the General Assembly on whether to accept federal funds for education reform ultimately led to the state not applying in future RTTT competitions. Thus, the lack of federal funds to support education reform meant that the state isolated itself from the influence of RTTT grant, which only further perpetuated isolation from other national reform efforts connected to the RTTT grant, particularly in the area of STEM.

Tennessee stands in direct contrast to South Carolina in how the RTTT incentives influenced STEM innovations. Since Tennessee was a first round winner, the federal government provided resources that made it possible to build partnerships with Battelle and other STEM related industries (as illustrated in Table 5), involving private institutions as well as public institutions. The state connected current innovations in STEM education reform and teacher preparation programs to STEM X membership, common core standards, replication of the UTeach program, the STEM advisory board, and later the work of the Complete College program. STEM innovations in research largely supported connections between UTK and federally funded projects, but these innovations did expand initiatives to other institutions like

the University of Memphis through the CRISTAL STEM research lab (see Table 4, Appendix D for details). As a result, Tennessee is good example of how federal support at the right time and around the right issue can influence the direction a state takes in policy innovation. The Tennessee case provides strong evidence of the presence of the national interaction model in how RTTT funding influenced the direction taken on STEM innovations.

As illustrated in Table 5, Georgia's most important STEM innovation, outside of accelerating the work already underway through the USG STEM Initiative, was the creation of an Innovation Fund, funded by RTTT funds. The Innovation Fund criteria directs grant applicants to develop partnerships in STEM education reform and STEM research which connect local K-12 schools with postsecondary education and industry. The primary institutional player is Georgia Tech through its CEISMC program. In the end, the Innovation Fund expands CEISMC's existing work while giving an opportunity for other institutions to build similar partnerships. Like Tennessee, RTTT funds made possible the replication of UTeach sites, but no additional state-sponsored initiatives resulted from RTTT funding (respondents did not cite any examples of legislative, non-profit association, or research initiatives resulting from receipt of RTTT funding). Thus, Georgia's focus was to secure additional funding for initiatives already underway (USG STEM Initiative listed in Table 5) and to provide the financial incentive for individual institutions to create STEM innovations that would connect K-12 with higher education. The RTTT funds provided needed resources to continue the work in STEM that the state identified as a priority prior to 2007 and perpetuated the influence of Georgia Tech's influence through its CEISMC program. While the state has continued to fund GRA as a state priority since 1998, respondents did not report GRA as a priority that needed additional support since the economic recession of 2007. Unlike Tennessee, the extent to which the RTTT funding

influenced STEM innovations, however, was limited in scope to the creation of funding sources for initiatives led by institutions rather than innovations administered by state agencies.

Influence of Regional Neighbors and Ideological Similarities

Diffusion policy studies often examine the influence of neighboring states on policy innovation since state policy makers must satisfice in their decision-making due to limitations on their time and information asymmetry. Often, state leaders turn to states that serve as regional pace setters or to states where leaders feel there is commonality in cultural, demographic, educational, or economic conditions. In contrast to the varied experiences in the three states along the previous two analytical dimensions, the cross-case comparison of the influence of regional neighbors and ideological similarities reveals convergence between states on the major regional state players and in the case of STEM, states are looking nationally. Table 6 summarizes the influence of regional neighbors in the three states. The number in parenthesis indicates the number of individual interviewees or the number of specific archival documents that reference the state listed.

Table 6. *Influence of Regional Neighbors and Ideological Similarities.*

	South Carolina	Georgia	Tennessee
Influence of regional neighbors and ideological similarities	Total: 22 Ohio (3) Texas (3) North Carolina (2) Virginia (2) Kentucky (2) Georgia/USG (2) Florida Wisconsin Colorado Arizona Washington	Total: 13 Ohio (3) Texas (3) Tennessee (2) Louisiana Florida North Carolina Oklahoma Colorado	Total: 22 Texas (5) Ohio (5) Kentucky (3) North Carolina (2) Georgia Look nationally (3) Feel TN is the leader (2) Look internationally

	New Jersey Look nationally (2)		
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The consensus among the three states is that when it comes to STEM innovations, everyone is looking nationally rather than regionally for best practices. As illustrated in Table 6, most respondents in South Carolina cited specific SREB states and the USG was specifically mentioned in reference to its strategic plan. Since the focus of South Carolina's higher education leaders has been on convincing the legislature to provide higher levels of state appropriations to higher education, comparisons with regional neighbors seems to be more relevant and therefore cited in responses as the reason why South Carolina leaders look to states regionally for data and best practices. When it comes specifically to STEM, however, Table 6 shows that South Carolina is similar to Tennessee and Georgia in that it views Ohio and Texas as the national leaders in STEM innovations. The absence of reference to either Tennessee or Georgia specifically related to STEM innovations is evidence that regional diffusion is not a factor in STEM policy innovations during the period of this study.

For Tennessee, the difference in some of the respondents' replies is due to the state's recent success in securing RTTT funds as well as its early adoption of the Complete College agenda. Policy leaders in Tennessee acknowledge that other states refer to Tennessee as a leader in STEM education reform and STEM innovations on a statewide level (reflected in Table 6). While this is certainly true in terms of the later rounds of RTTT funding, during which states looked at Tennessee's grant and incorporated some of the STEM innovations, there was no specific mention of Tennessee as a leader by the other states in this study. One Tennessee higher education official cited that national non-profits and other states frequently approach Tennessee

for assistance in STEM innovations, particularly since the RTTT award. Thus, it is likely that Tennessee officials feel other states look to them as the leader because of the national attention placed on education reform and college completion rather than specifically for its STEM innovations. Again, no evidence exists in this study to indicate the presence of regional diffusion related to STEM innovations occurring during this time.

As illustrated in Table 6, Georgia is similar to South Carolina and Tennessee in that it looks to Ohio and Texas as states setting the tempo in STEM innovations nationally. Policy leaders explained their comparisons to other states such as Florida and North Carolina because of the similarity in state population and economic development challenges. While there was an acknowledgement that North Carolina has a history of being a regional leader and Florida is viewed as being a charter-friendly state, which appealed to the particular political interests in Georgia at this time, there is no indication that regional diffusion is occurring around STEM innovations in Georgia.

Interactions between State Leaders within a Region

Another indication of regional diffusion would be the frequency of interactions between state leaders within a region. The focus of this study limited participants to members of SREB states to account for interactions that may occur between state leaders within the region. As would be expected, Table 7 illustrates that if states are looking nationally for best practices in STEM, few interactions between state leaders within a region around STEM would take place. State leaders cite participation in national and regional associations as the primary means by which they interact with state leaders within the region in order to learn best practices.

Table 7. *Interactions between State Leaders within a Region.*

	South Carolina	Georgia	Tennessee
Interactions between state leaders within a region	SREB	<p>SREB</p> <p>Diploma Project and Complete College America membership gave them access to data and best practices among leaders</p> <p>Governor intentionally did not involve associations in RTTT program proposal planning to limit influence</p>	<p>Diploma Project, Achieve, Education Trust, and Education Delivery Institute, Complete College America membership gave them access to data and best practices among leaders</p> <p>Education First had connections with Ohio/Battelle</p>

While South Carolina and Georgia respondents named SREB, Table 6 explains how Tennessee and Georgia respondents cited membership in national reform programs like the Diploma Project and Complete College America as the most prevalent way in which they are interacting with each other. Because South Carolina was not a member of either at the time of this study, it would again appear that national reform efforts are providing the primary mechanisms to advance particular practices in STEM. Furthermore, Tennessee officials mentioned connections with Battelle as fostering network connections with the State of Ohio. Again, this supports the idea that states are looking nationally, rather than regionally for STEM innovations.

Competition with Neighboring States for Resources

This study examines how STEM innovations rise to the governing board agenda during a period of economic crisis and uses diffusion models to explain how states adopt innovations

between states within a particular region. As part of this examination, respondents were asked if there is a perception of competition for resources between states that may be leading the state towards particular innovations. In none of the cases examined here did a respondent mention competition for resources with other states as the driver of STEM innovations. Respondents stated that when it comes to STEM, institutions are competing with each other for federal grants, which further emphasizes how competition for resources in STEM research largely exists among the top-tier research institutions who are seeking to maintain a certain level of research funding nationally. Table 8 summarizes that no respondents viewed any competition with neighboring states for resources.

Table 8. *Competition with Neighboring States for Resources.*

	South Carolina	Georgia	Tennessee
Perception of competition with neighboring states for resources	Nothing mentioned	Nothing mentioned	Nothing mentioned

Institutionalization of STEM

Perhaps the greatest role that a state's governance structure plays in advancing particular STEM innovations can be seen in the institutionalization of STEM innovations on the state level. Through the establishment of standardized rules, process, or expectations, states are able to advance STEM innovations that support state goals. Depending on the structure of higher education governance in the state and the state's higher education governing agencies relationship with the executive and legislative branches, the higher education governance system may act as a mechanism that reinforces these process or expectations to member institutions.

Table 9 summarizes the major standardized rules, process, or expectations cited by respondents or found through the document analysis.

Table 9. Standardized Rules, Processes, or Expectations.

	South Carolina	Georgia	Tennessee
Standardized rules, processes, or expectations that may indicate the role of institutionalized practice on what STEM innovations were further advanced	NSF grant which led to S2Mart Initiative SC's Education and Economic Development Act Personal Pathways to Success SmartState program Palmetto Fellows and Life Scholarship program SC Code of Law: Critical success factors and performance indicators State structure with Board of Education does not direct specific operations – outside influence is limited	NSF MSP funding which led to USG STEM Initiative Previous work of Georgia Tech through CEISMC Governor's Strategic Plan HB 280, STEM teacher differentiated pay Innovation Fund administered through Governor's Office of Student Achievement Professional Standards Commission Charter friendly state Right-to-work state	Executive Order No. 68 establishing TN STEM Innovation Network American Diploma Project Complete College Tennessee Act in 2010 EPSCoR grant: TN-SCORE Previous work with Battelle through ORNL Outcomes based funding formula THEC public agenda THEC supply-demand study

As illustrated in Table 9, in South Carolina, federally funded programs like the NSF grant that led to the S2Mart Initiative were not the only ways in which the state advanced STEM innovations. The South Carolina Education and Economic Development Act was a major

catalyst for providing funding for STEM innovations in the state prior to the RTTT grant application. Furthermore, the legislature supported recruitment of students into STEM fields through the Palmetto Fellows and Life program. The state also encouraged institutional success in STEM by incorporating STEM into the South Carolina Code of Law as a performance indicator for higher education institutions, which drives institutional funding from the state. Therefore, the EEDA, scholarship programs, and the performance indicators are the major ways in which the state is attempting to institutionalize and give legitimacy for a statewide priority focus on STEM. Institutional theory explains how such actions led to further legitimacy and reinforce the emphasis on STEM within higher education institutions. Unlike Georgia and Tennessee, which have stronger governance structures, specific reference by respondents to the lack of coordination or formal guidelines, listed in Table 9, illustrates how South Carolina lacked more formal strategies or procedures to institutionalize specific STEM initiatives statewide. As such, institutions work largely on their own in connecting with federally sponsored STEM initiatives or with private donors.

Tennessee's coordinating board, THEC, has a close relationship with the state's legislative body and executive branch. As such, it is no surprise that in Tennessee most changes in education reform occurred through the passage of legislation. The process of passing legislation or in issuing an executive order creates formal rules by which institutions must adhere to operationally. As listed in Table 9, for Tennessee, this process could be seen in the issuance of Executive Order No. 68 that established the Tennessee STEM Innovation Network and the Complete College Tennessee Act. The coordinating agency then reinforces this legislation through its governance of the UT and TBR systems. The standardization of behavior across institutions is further supported by THEC's public agenda, which mirrors the goals of the

legislation, and then through the supporting research, analysis, and recommendations THEC undertook in the supply-demand study and the outcomes based funding formula proposal to the state legislature. Institutional theory explains how the issuance of legislation and the standardization of institutional behavior through THEC's outcomes-based funding formula not only reinforce specific actions related to the STEM agenda, but also the major actors who are to take part in STEM innovations. Furthermore, Tennessee's participation in the American Diploma Project is a specific example of how normative isomorphism is occurring in educational standards nationwide. As was discussed earlier, the Diploma Project, which is coordinated by Achieve and is a collaborative venture with several states, resulted in the 2008 adoption of the Tennessee Ready Core, the 2009 adoption of academic standards, and the 2010 adoption of the Common Core State Standards. The creation of the TSIN (through Executive Order 68), is an example of mimetic isomorphism since respondents stated it was modeled after the Ohio STEM Network. In summary, Tennessee's strategy behind the implementation of STEM innovations illustrates the institutionalization of STEM innovations throughout each layer of state governance, down to the implementation of specific standards at the institutional level, which guides behavior in STEM.

In a similar fashion, Georgia also passed legislation that reinforced how officials should recruit and hire more qualified STEM teachers in the state. As referenced in Table 9, the role of the Professional Standards Commission in K-12 education and teacher credentialing reinforces a standardization of practice across the state in K-12 STEM education. On the postsecondary level, the USG STEM Initiative, the role of Georgia Tech/CEISMC in working with STEM teacher preparation programs, and the Governor's Strategic Plan directly influenced the creation of the Innovation Fund. In turn, the Innovation Fund provided the means through which the state

further encourages particular STEM innovations that partner K-12 with higher education – so that it gains in legitimacy and becomes taken for granted as the way in which things are done. Administered through the Governor’s Office of Student Achievement, the Innovation Fund aligns funding to state goals and national priorities in STEM as part of the RTTT grant. Thus, institutional theory explains how Georgia’s adoption of teacher and educational standards are advancing STEM innovations on the state-level.

CHAPTER EIGHT

CONCLUSION

This final chapter provides a brief review of the study, reports five key findings as a result of the cross-case analysis, and offers implications for research and policy.

Review of the Study

The purpose of this dissertation is to describe how STEM innovations emerge on the state higher education agency agenda during a time of economic recession. The intent of this case study is to focus on the external influences that raise particular STEM innovations to the state policy agenda. Three theories of policy diffusion - national interaction (Berry, 1994; Gray, 1973; Walker, 1969), regional diffusion (Berry & Berry, 1990; Berry, 1994; McLendon, 2003; McLendon, Heller, & Young, 2005), and institutional theory (Covaleski & Dirsmith, 1988; Colyvas & Johnson, 2011; Colyvas & Powell, 2006; DiMaggio & Powell, 1983) have guided this comparative case study of three states' STEM innovations. Often, diffusion studies only explore enacted policy innovations, policy adoptions, and the influence this has on neighboring states. This study examined three states at different stages of policy innovation, including one state viewed as a "non-adopter" in order to examine how policy leaders perceive the role of national and regional networks in guiding practice.

Ultimately, state economic partnerships and the future forecast of job creation is part of the conversation around STEM innovations and only reinforced the importance of STEM when the economic recession took hold. With higher education viewed as a vital piece to growing the state's economy, higher education is connected to STEM innovations in a multitude of ways.

Federal economic stimulus funds increased the level of funding available for STEM research, but institutions pursued these funds individually rather than through a coordinated state approach. Thus, when the Obama administration made available economic stimulus funds through the Race to the Top program, states looked to tailor their STEM innovations to the federal education reform agenda. Only under the right conditions, did state governing systems for higher education become directly involved in coordinating STEM innovations arising from the RTTT grant application.

Four factors contributed to the conception of this dissertation topic. First, state leaders have come to view higher education as one major policy sector in which states can leverage for economic development and for the achievement of state economic goals. Second, the economic downturn in 2007 forced higher education institutions and agencies to think strategically about how to support institutional missions and academic initiatives. Third, with the exception of one study, previous studies largely examine enacted policy innovations, policy adoptions, and the influence this has on neighboring states, leaving room for the exploration of why states *may not* pursue particular innovations. Fourth, and finally, despite the growing number of studies on the effects of higher education governance structure, researchers have paid little attention to how STEM innovations come to be on the state higher education agency agenda.

Relying upon archival documents and interview data collected from actors in three states, Chapters 4, 5, 6 present case studies of how STEM innovations rose to the higher education governing agency's agenda between 2007 and 2012. These cases describe the internal and external influences on STEM innovations through a narrative chronology of events and analyze the diffusion of innovations across six dimensions of the analytic framework outlined in Appendix D. Chapter 7 continues the examination of the policy process through cross-case

analysis. Finally, this concluding chapter reports key findings emerging from this analysis and presents implications for future research and policy considerations.

Findings

Within this study, the national interaction model and regional diffusion model examine more fully the extent by which the federal government, professional associations and neighboring political leaders influence STEM innovations on a state-level. A third framework, institutional theory, examines the standardization of practices either through legislation, rules, or norms that may influence state-level STEM innovations. This study identifies STEM innovations that rose to the higher education governing agency's agenda during a period of economic recession. While none of the findings in this study are particularly new, they lay the foundation for further work on the nuances found among the states in this study. For example, Georgia was expected to illustrate a stronger coordination of STEM innovations as a result of its consolidated governing board structure, but in contrast, Tennessee emerged as more innovative. Due to Tennessee's coordinating structure, which is closely (even if informally) connected to the Governor's office, the influence of network connections between state leaders and national reform organizations directed THEC's role in coordinating implementation across its two systems.

The central finding from this study is the substantial role of network connections in advancing STEM innovations on a state-level. There is evidence to suggest that national non-profits play a significant role in agenda setting – perhaps more so than the state policy leaders and state governing agencies are playing themselves in the agenda setting process. Professional networks play vital roles in STEM innovations and support the conceptual relevance of the national interaction model and institutional theory. As illustrated in the Tennessee case, policy

actors among national non-profit agencies can influence the direction a state takes by offering financial incentives to be part of a national reform effort. A second way in which there is evidence of national interaction is through the adoption of similar STEM innovations across the states. Among the respondents in this study, there was consensus that Ohio and Texas were states that had programs worth replicating in the area of STEM.

The role of professional networks also indicates mimetic and normative isomorphism is occurring among states in STEM innovations. In Tennessee, normative isomorphism is evidenced in the state's adoption of Common Core Standards, replication of the UTeach program, and early adoption of the Complete College program. Through the state's connections with Achieve, policy leaders are circulating ideas within their own system and sharing best practices on these programs that are later incorporated into the state's reform efforts. Mimetic isomorphism is also evident in the Tennessee and Georgia cases. Specific mention of the Ohio STEM Network as a model worth replicating was present not only in respondent interviews, but also in the document search. In Tennessee, the creation of TSIN, which is modeled after the Ohio STEM Network, is a specific example of mimetic isomorphism.

This study also led to the discovery of four additional findings:

1. A state's higher education governance structure affects how STEM policy comes to be on the higher education governing board's agenda. As described by McGuiness (1988), consolidated and strong coordinating boards are more likely to produce significant innovations, with coordinating boards more closely aligned to state legislatures. THEC, as a strong coordinating board and one closely aligned to the state legislature and governor's office, played a significant role in institutionalizing STEM innovations by aligning the Public Agenda to the First to the Top and Complete College Tennessee Act.

For South Carolina, with a weak coordinating board, the coordinating agency has accomplished little with STEM innovations because of the lack of authority to coordinate a state-level effort and a lack of funding support from the legislature for reform initiatives. In contrast, within the University System of Georgia, the agency provides centralized coordination over all public postsecondary institutions in the state. As such, coordination of STEM innovations are tied to larger statewide or federally funded initiatives managed directly by the USG without formal legislation to direct these efforts.

2. Economic and political characteristics matter more than regional diffusion in STEM innovation. While none of the respondents stated the economic recession was used as rationale for the state to engage in certain state-level STEM innovations, all states faced budget shortfalls that provided the motivation to secure additional funds. States needed supplementary funds either to maintain existing STEM-related programs (like the USG STEM Initiative in Georgia) or to accelerate the work in STEM already underway (as was the case in both Tennessee and Georgia). South Carolina, as a non-adopter, bucked this trend because of a unique anti-federalist culture and internal determinants. These internal determinants included low levels of state appropriations to higher education and a weak coordinating board that mitigated the influence of federal and national non-profit association involvement within the state. In all three states, the work of neighboring states was not factored into what STEM innovations to include in the initial application. Instead, any new program ideas that were adopted came out of the state's association through national networks and associations.

3. States seek to maximize federal funding by aligning existing statewide initiatives with federal policy goals. Race to the Top is an example of vertical diffusion of policy ideas;

whereby, states aligned their education reform plans to comply with the competitive preference area focused on STEM. In Georgia and Tennessee, the incentive of RTTT funds led the state to examine what was required in the application and blend it with the state's priorities and efforts already underway in education reform. The result was that both states examined how they could leverage the RTTT funds to accelerate work in progress. The RTTT grant focused policy leaders' attention on STEM and made states rethink connections to higher education because these elements were required criteria in the RTTT application.

4. Institutionalization of STEM is occurring not only through enacted legislation, but also through unspoken expectations that reinforce social structures. Institutional theory places an emphasis on how rules, norms, and routines build social structures. Through the creation and adoption of certain ways of doing things, the actions become legitimized by individual units and later by the larger group. Even outside of RTTT funding, proof of the institutionalization of specific expectations related to STEM is evident. In Tennessee, the Complete College Tennessee Act specifically mentions the goal of having UTK enter into STEM related partnerships with the Oak Ridge Lab around alternative energy, directing the institution's work in STEM. During initial discourse about the legislation, however, respondents cited how institutional leaders noted the exclusion of other research universities and voiced objections, which resulted in the addition of the Memphis Research Consortium into the Complete College Tennessee Act. In South Carolina, the General Assembly used legislation for specific initiatives arising from the SmartState program and through the passage of the Education and Economic Development Act in 2005. Yet, respondents cited how the unspoken expectation is that research institutions

seek out federal grant opportunities in STEM that align with state economic goals. In Georgia, the involvement of Georgia Tech's CEISMC program in STEM teacher preparation and its role as lead collaborator with school districts on Innovation Fund initiatives, illustrates an unspoken understanding that CEISMC is pre-eminent in STEM education within the state. Thus, in both Tennessee and Georgia, the institutionalization of STEM seems to benefit the high-resource public research universities.

Conceptual Implications

This dissertation sought to examine the explanatory power of three theories on how STEM innovations rise to the state governing board's agenda in three states during a period of economic recession. The core finding from this study—the substantial role that national networks play in advancing particular STEM innovations nationally—illustrates the importance of the national interaction model in explaining how federal incentives and interactions between professionals within national professional associations leads to the replication of particular practices and policies. The examination of South Carolina, a state that did not participate in a federal grant program, reveals that if a state is not part of a national network they fall further behind in advancing particular innovations. The use of the national interaction model in examining external influences on state policy illustrates the increasing professionalization in higher education as well as how professionals are increasingly looking nationally for best practices. This density of networks is an area worth further examination as researchers continue to identify influences on the agenda making process and therefore supports the need for continuing to use the national interaction model when examining diffusion of policy ideas.

On the other hand, regional diffusion did not seem to provide a theoretical explanation for how STEM policy emerges on the state governing board's agenda. This finding runs counter

to earlier studies done on higher education finance (Doyle, 2006; McLendon, Heller, & Young, 2005). Furthermore, this finding also contradicts results from a recent study conducted by Levine, Lacy, & Hearn (forthcoming) which examined STEM cell research policies in the United States. Specifically, the researchers found that states that previously adopted restrictive STEM cell policy had a positive effect on whether a neighboring state would adopt a supportive STEM cell policy. This particular study illustrates how states innovate away from their neighbors as a form of interstate competition. The difference in types of policy may explain why regional diffusion provides theoretical support in one arena and in others does not provide theoretical support for how state leaders innovate in higher education policy.

The third theory used in this study, institutional theory, is closely intertwined with the role of the national interaction model in explaining how STEM policy innovations are advanced among the states. Professional networks play vital roles in STEM innovations and support the conceptual relevance of institutional theory. As behaviors gain in acceptance as the “way things are done,” evidence of the institutionalization of STEM innovations reveals how federal funding not only incentivizes states to enact particular STEM innovations, but also systematically changes the way in which professionals think about STEM innovations. Institutionalization of practice can be seen in both the “build up” from the micro level and “pulled down” effect from the macro level (Powell & Colyvas, 2008). In Tennessee, evidence exists to show how discourse from membership in associations influenced the direction institutional leaders took in regards to STEM innovations; connecting the state’s efforts to other national reform programs that the state was connected to and to partners already at work within the state. At the same time, the umbrella organizations are dictating implementation of practice through legislation that served to institutionalize STEM innovations.

Research Implications

Ultimately, this data provides useful information on how professional networks play a role in institutionalizing specific practices. Quasi-governmental associations such as the National Governors Association (NGA), the National Conference of State Legislatures (NCSL), and the Council of State Governments (CSG) provide network opportunities to share best practices in policy innovation, but the pervasiveness of non-profit educational reform organizations appears to have even greater influence on policy innovation than originally imagined. Additional research on the influence of national non-profits on educational reform may yield information about the frequency of specific network actors who contribute to the proliferation of specific STEM innovations. How do these network actors connect with other federal initiatives? Is there a pattern between the formation of the education reform agenda of these non-profit organizations and the federal education reform agenda? Alternatively, do national non-profit organizations form in response to a changing federal agenda?

Numerous studies have shown that state governments tend to emulate the policy behavior of their neighbors. What, therefore, accounts for why policy leaders do not look to neighboring states on some policy issues and others they do? Does a shifting economic condition and federal priorities attribute to whether leaders are interested in what their state neighbors are doing? Or do other political influences have an effect on reform trends? While this study examined how STEM innovations rose to the state governing board's agenda during a period of economic recession, comparisons with other state's reform efforts during this period may reveal patterns in diffusion outside of STEM during this same time. Different types of policies may have unique adoption patterns.

The role of private institutions in STEM innovations during a period of economic recession could also be further explored. In Tennessee, respondents frequently cited the involvement of Vanderbilt University in statewide STEM initiatives, particularly in teacher preparation and research. In contrast, respondents never mentioned Georgia's Emory University as a major policy player in statewide initiatives even though its national ranking in research closely trails Vanderbilt and Georgia Tech. Emory University is also an integral partner in the Georgia Research Alliance, which participants also did not mention. Differences in the higher education governance structure between the two states may account for how states involve private institutions in statewide planning and coordination of STEM related innovations. A closer examination of the role of privates in the discussion about state-level STEM innovations may reveal nuances in the governance, political, or cultural structures that exist within a state that either promote or exclude private institutions.

This study relied on interview and archival data from three states at different phases in the RTTT grant process. As such, the findings from this study are limited and could be expanded in future research by studying additional states that secured RTTT funding compared with those states that competed for funding, but did not receive funds. Expanding this work would enable a researcher analyze whether similar elements of diffusion in STEM policy exist between states outside of the region and whether similar network actors influenced these STEM innovations.

A longitudinal study of the impact of RTTT funding on STEM innovations would build upon this work and provide additional information on the institutionalization of STEM innovations funded through the grant. This would provide additional information on which innovations were later adopted in other states that were not part of the RTTT grant competition.

Furthermore, a longitudinal analysis of states that do not participate in national reform initiatives may illustrate what, if any, long-term ramifications exist, particularly related to the procurement of external funding sources. If a state is not an early adopter of a reform effort, are they shut out later from other external funding opportunities?

Policy Implications

The diffusion of policy innovations is one major way in which states, especially those with fewer resources, gain new information about STEM policy “best practices” and seek to improve their competitiveness. Given the amount of money states spend each year on research and the increasingly research-oriented nature of state economies, understanding the diffusion of these policy innovations at the state level is a critical step in doing policy research that has practical applications for the policymaking process. As states continue to face budget constraints and pressure to raise student competence in STEM fields, they will have to think strategically about reform efforts that will yield the greatest return for their investment. As such, understanding the characteristics of diffusion is particularly important to research efforts in these states.

With the increase in the number of national non-profits providing financing for educational reform and a competitive national arena for federal research dollars, regional diffusion may have lost of some its explanatory power when examining particular education issues. Because of increases in technology and greater availability of policy documents and information between states through quasi-governmental organizations and national non-profits, state policy leaders are engaging with each other on a broader scale than ever before. As specific policy needs arise, new associations form to address communication and information sharing. Additionally, participation in federal grants creates natural interest groups who share information

between states. Thus, regional diffusion may become less relevant in the discussion of how STEM policy innovations are shared between neighboring states.

Due to the increasing pressure from external non-profits and federally funded education reform programs, normative pressure rather than competitive pressure between the states may become more of a policy consideration. As professional associations of governmental and higher education officials has expanded in size and diversity, these groups serve as conduits of interstate communication and “cutting edge” policies may increase as officials strive to be leaders in policy design. The result may be a desire by state leaders to be involved in national reform initiatives for the sake of playing in the game, rather than competing for resources. While this study provides insight into how particular STEM innovations rise to the state governing board’s agenda during a period of economic recession, these considerations suggest that the greater influence on STEM innovations is national policy organizations that seek to assist states in securing federal financial support to advance a state’s current educational and economic agenda.

REFERENCES

- Achieve. (2012). Our History. Retrieved August 5, 2012 from: <http://www.achieve.org/history-achieve>
- Achieve. (2011, July). Tennessee's College and Career-Ready Commitment. Retrieved September 9, 2012 from: www.achieve.org/files/Tennessee-CCRFactSheet-July2011.pdf
- Alliance of Education Agency Heads. (2009). *Strengthening Georgia's education system through statewide collaboration*. Retrieved November 4, 2012 from: www.ecs.org/html/meetingevents/nf2009/resources/AmyMast.pps
- Atlanta-Journal Constitution. (2010, August 10). *Race to the top means \$400 million for Georgia*. Retrieved November 17, 2012 from: <http://www.ajc.com/news/news/local/race-to-the-top-win-means-400-million-for-ga/nQjdH/>
- Battelle. (2010). Battelle/BIO State Bioscience Initiatives 2010: State Initiatives Report. Retrieved July 17, 2011 from: <http://www.bio.org/local/battelle2010/>
- Battelle. (2012). Our Work: Education. Retrieved August 5, 2012 from: <http://www.battelle.org/our-work/education>
- Beamer, G. (2002). Elite interviews and state politics research. *State Politics and Policy Quarterly*, 2 (1), 86-96.
- Beyle, T. (2004). The governors. In V. Gray and R.L. Hanson (Eds.), *Politics of the American States*. Washington, DC: CQ Press.
- Beyle, T. & Ferguson, M. (2008). Governors and Executive Branch. In V. Gray and R. Hanson, (Eds.), *Politics in the American States: A Comparative Analysis*. Washington, D.C.: CQ Press, 192-228.
- Berdahl, R.O. (1971). *Statewide coordination of higher education*. Washington, D.C.: American Council on Education.
- Berry, S. (1994). Sizing up state policy innovation research. *Policy Studies Journal*, 22, 442-456.
- Berry, S. & Berry, W. (1990). State lottery adoptions as policy innovations: An event history analysis. *American Political Science Review*, 84, 395-415.
- Berry, S. & Berry W. (2007). Innovation and diffusion models in policy research. In Sabtier, P. (ed.), *Theories of the Policy Process*. Boulder, CO: Westview Press.
- Bok, D.C. (2002). *Universities in the marketplace: The commercialization of higher education*. Princeton, N.J.: Princeton University Press.

- Center for Business and Economic Research. (2011). Academic Program Supply and Occupational Demand Projections: 2008-2018. The University of Tennessee: Knoxville, TN. Retrieved September 1, 2012 from: http://tn.gov/thec/Divisions/AcademicAffairs/academic_programs/THEC%20supply%20and%20demand%20Final.pdf
- Chronicle of Higher Education. (2012, August). *Almanac Issue 2011-12*. Retrieved August 31, 2012 from: <http://chronicle.com/section/Almanac-of-Higher-Education/615/>
- Chronicle of Higher Education. (2012, October 1). *With State Support Now Tied to Completion, Tennessee Colleges Must Refocus*. Retrieved October 1, 2012 from: <http://chronicle.com/article/Completion-Is-New-Key-to-Cash/134752/>
- The Citadel. (2011). *The STEM Center of Excellence at The Citadel: Report of Activities for Academic Year 2010-2011*. Retrieved on October 6, 2012 from: http://www.citadel.edu/stemcenter/images/files/stem_center_annual_report_2010-2011.pdf
- Coburn, C.M., & Brown, D.M. (1998). State Governments: Partners in Innovation. In L. Branscomb and J. Keller (eds.), *Investing in innovation: Creating a research and innovation policy that works*. Cambridge, MA: MIT Press. (p. 422-437).
- Complete College America. (2012). *Alliance of States*. Retrieved on August 5, 2012 from: <http://www.completecollege.org/>
- Covaleski, M.A., & Dirsmith, M.W. (1988). An institutional perspective on the rise, social transformation, and fall of a university budget category. *Administrative Science Quarterly*, 33, 562-587.
- Colyvas, M.A. & Jonsson, S. (2011, March). Ubiquity and legitimacy: disentangling diffusion and institutionalization. *Sociological Theory*, 29(1), 27- 53.
- Colyvas, J.A. & Powell, W.W. (2006). Roads to institutionalization: The remaking of boundaries between public and private science. *Research in Organizational Behavior*, 27, 305-353.
- Council of State Government. (2007). *The Book of the States*. Retrieve August 5, 2012 from: <http://www.csg.org/policy/publications/bookofthestates.aspx>
- Council of State Government. (2009). *The Book of the States*. Retrieved August 5, 2012 from: <http://www.csg.org/policy/publications/bookofthestates.aspx>
- Council of State Government. (2011). *The Book of the States*. Retrieved August 5, 2012 from: <http://www.csg.org/policy/publications/bookofthestates.aspx>
- Dill, D.D. (2003). Allowing the market to rule: The case of the United States. *Higher Education Quarterly*, 57(2), 136.

- DiMaggio, P.J., & Powell, W.W. (1983). The 'iron cage' revisited: isomorphism and collective rationality in organization fields." *American sociological review* 48: 147-60.
- Education First. Who We Are. (2012). Retrieved August 5, 2012 from: <http://www.education-first.com/who-we-are>
- Emory University. (2012, October 17). *Emory external research funding tops \$500 million for third year*. Retrieved November 3, 2012 from: http://news.emory.edu/stories/2012/10/research_story_2012/campus.html
- Erlandson, D., Harris, E., Skipper, B., & Allen, S. (1993). *Doing Naturalistic Inquiry: A Guide to Methods*. Newbury Park, CA: Sage Publications.
- Geiger, R., & Sá, C. (2005). Beyond technology transfer: US state policies to harness university research for economic development. *Minerva: A Review of Science, Learning & Policy*, 43(1), 1-21. doi: 10.1007/s11024-004-6623-1
- Georgia Office of the Governor. (2012, January). *Deal announces second round of race to the top grant winners*. Retrieved online November 17, 2012 from: <http://gov.georgia.gov/press-releases/2012-01-11/deal-announces-second-round-race-top-grant-winners>
- Georgia Office of the Governor. (2011, August 4). *Deal announces \$1 million grant, complete college Georgia initiative*. Retrieved November 17, 2012 from: <http://gov.georgia.gov/press-releases/2011-08-04/deal-announces-1-million-grant-complete-college-georgia-initiative>
- Georgia Office of the Governor. (2011, October 13). *Deal names higher education funding commission*. Retrieved November 18, 2012 from: <http://gov.georgia.gov/press-releases/2011-10-13/deal-names-higher-education-funding-commission>
- Georgia Office of Planning and Budget. (2011, March 31). *Race to the top innovation fund: Request for proposals announcement and application instructions*. Atlanta, GA: Governor's Office.
- Georgia Office of Planning and Budget (2012). *Governor's strategic goals for Georgia*. Retrieved November 17, 2012 from: http://opb.georgia.gov/sites/opb.georgia.gov/files/imported/vgn/images/portal/cit_1210/28/43/183929804State%20Goals%20April%202012%20FINAL.pdf
- Georgia Institute of Technology. (2010, November 8). *Georgia Tech provides support for the state's race to the top program*. Retrieved November 2, 2012 from: <http://www.gatech.edu/newsroom/release.html?nid=62594>
- Georgia Research Alliance. (2013). *Origins*. Retrieved January 31, 2013 from: <http://gra.org/AboutGRA/Origins.aspx>

- Georgia Research Alliance. (2012). *2012 Annual Report: 50 milestones that defined the year 2012*. Retrieved January 31, 2013 from: <http://gra.org/Portals/11/PubsFiles/2012AnnualReport.pdf>
- Gray, V. (1973). Innovation in the states: A diffusion study. *American Political Science Review*, 67, 1174-1185.
- Health Sciences South Carolina. (2012). *About HSSC*. Retrieved October 7, 2012 from: <http://www.healthsciencessc.org/about.asp>
- Hearn, J.C. (2003). *Diversifying campus revenue streams: Opportunities and risks*. Report for the American Council on Education series: Informed Practice: Syntheses of higher Education Research for Campus Leaders. Washington, DC: American Council on Education.
- Hearn, J. C., Griswold, C.P., & Marine, G.M. (1996). Region, resources, and reason: A contextual analysis of state tuition and student aid policies. *Research in Higher Education*, 37(3), 241-278.
- Hearn, J. C., McLendon, M.K., Lacy, T.A. (2009). *The emergence of state-funded "eminent scholars" programs: University faculty recruitment as a policy instrument*. Paper presented at the Midwest Political Science Association, April 5, 2009.
- Higher Education Study Committee. (2009). *Leveraging Higher Education for a Stronger South Carolina: The Action Plan Implementation*. Retrieved online on May 19, 2012 from: http://www.che.sc.gov/InfoCntr/HESC_Files/che_2169_Leverage_Report_web.pdf
- Kirp, D. (2003). *Shakespeare, Einstein, and the bottom line: The marketing of higher education*. First Harvard University Press.
- Leslie, D., & Novak, R. (1998). Substance versus policies: Through the dark mirror of governance reform. *Educational Policy*, 17(1), 98-120.
- Levine, A., Lacy, T., & Hearn, J. (forthcoming). The origins of human embryonic stem cell research policies in the US states. *Science and Public Policy*.
- Lincoln, Y.S., & Guba, E.G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. In Williams, D.D. (ed.) *Naturalistic Evaluation*. American Evaluation Association: New Directions for Program Evaluation. San Francisco, CA: Jossey Bass.
- Lincoln, Y.S., & Guba, E.G. (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications.
- Lyall, K. (1986). The spectrum of college and university roles in economic development. In *The higher education – economic development connection: Emerging roles for public colleges and universities in a changing economy*. Washington, D.C.: American Association of State Colleges and Universities.

- Martinez, M.C. (2002). Understanding state higher education systems: Applying a new framework. *The Journal of Higher Education*, 73(3), 349-374.
- McGuiness, A.C. (1988). State postsecondary education structures handbook. Denver, CO: Education Commission of the States.
- McGuiness, A. (2005). The states and higher education. In P.G. Altbach, R.O. Berdahl & P.J. Gumport (Eds.), *American higher education in the twenty-first century: Social, political, and economic challenges* (Second ed., pp. 198-225). Baltimore, MD: The John Hopkins University Press.
- McLendon, M.K. (2003a). State governance reform of higher education: Patterns, trends, and theories of the public policy process. In J.C. Smart (ed.), *Higher Education: Handbook of Theory and Research*, Vol. XVIII, 57-144. New York: Agathon Press.
- McLendon, M. K. (2003b). Setting the governmental agenda for state decentralization of higher education. *The Journal of Higher Education*, 74(5), 1-37.
- McLendon, M.K., Deaton, R., & Hearn, J.C. (2007). The enactment of reforms in state governance of higher education: Testing the political instability hypothesis. *The Journal of Higher Education*, 78(6), 645-675.
- McLendon, M.K. & Hearn, J.C. (2007). Incorporating political indicators into comparative state study of higher education policy. In Shaw, K. & Heller, D. (eds.), *State Postsecondary Education Research: New Methods to Inform Policy and Practice*, 11-36.
- McLendon, M.K., Hearn, J.C., & Mokher, J.C. (2009). Partisans, professionals, and power: The role of political factors in state higher education funding. *The Journal of Higher Education*, 80(6), 686-713.
- McLendon, M., Heller, D., & Young, S. (2005). State postsecondary policy innovation: Politics, competition, and interstate migration of policy ideas. *The Journal of Higher Education*, 76(4), 363-400.
- McLendon, M.K., & Ness, E.C. (2003). Politics of state higher education governance reform. *Peabody Journal of Education*, 78(4), 66-88.
- Merriam, S.B. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.
- Mingle, J.R., & Epper, R.M. (1997). State coordination and planning in an age of entrepreneurship. In Goodchild, L.F., et al. (Eds.) *Public Policy and Higher Education*. ASHE Reader Series. MA: Simon & Schuster (p. 476-490).
- Morphew, C.C., & Eckel, P.D. (2009). *Privatizing the public university: perspectives across the academy*. Baltimore, MD: The John Hopkins University Press.

- National Governors Association. (2011). *Degrees for what jobs? Expectations for universities and colleges in a global economy*. Retrieved February 1, 2011 from: <http://www.nga.org/Files/pdf/1102DEGREESJOBS.PDF>
- National Governors Association. (2007). *Innovation America: A partnership*. Paper by the National Governors Association and Council on Competitiveness. Retrieved April 1, 2011 from: <http://www.nga.org/Files/pdf/0702INNOVATIONPARTNERSHIP.PDF>
- National Science Foundation. (2010). *Award abstract #1006833: South Carolina inter- and intra- campus cyber connectivity (C2)*. Retrieved October 7, 2012 from: www.nsf.gov/awardsearch
- National Science Foundation. (2010). National impact report: Math and Science Partnership Program. Retrieved November 4, 2012 from: <http://www.nsf.gov/pubs/2010/nsf10046/nsf10046.pdf>
- Ness, E. C., & Mistretta, M. A. (2010). Merit Aid in North Carolina: A Case Study of a "Nonevent". *Educational Policy*, 24(5), 703-734. Retrieved from EBSCOhost.
- Ness, E.C. & Mistretta, M.A. (2009). Policy Adoption in North Carolina and Tennessee: A comparative case study of lottery beneficiaries. *Review of Higher Education*, 32 (4): 489-514.
- New Economy Strategies. (2006). *Tennessee innovation road map: Building Tennessee's technology economy*. Retrieved September 8, 2012 from: www.tnepscor.org/sites/www/Uploads/Files/TIRM.pdf
- Nicholson-Crotty, J., & Meier, K.J. (2003). Politics, structure, and public policy: The case of higher education. *Educational Policy*, 17(1), 80-97.
- Office of Educational Access and Success, University System of Georgia. (2012, March). *A review of state-level programs to enhance postsecondary STEM education in the United States*. Report prepared by the Office of Educational Access and Success, Center for 21st Century Universities, Center for Advanced Communications Policy, & Georgia Institute of Technology. Retrieved November 3, 2012 from: c21u.gatech.edu/.../OEAS_12-02_State_Level_Programs_for_STEM
- Powell and Colyvas. (2008). Microfoundations of Institutional Theory. In R. Greenwood, et al. (Eds.), *The SAGE Handbook of Organizational Institutionalism*, Thousand Oaks, CA: Sage Publications, pp. 276-298.
- Professional Science Master's Degree. (2012). *PSM Overview*. Retrieved September 9, 2012 from: www.sciencemasters.com

- Pusser, B., Slaughter, S., & Thomas, S. L. (2006). Playing the board game: An empirical analysis of university trustee and corporate board interlocks. *Journal of Higher Education*, 77(5), 747-775.
- Rubin, H.J., & Rubin, I. (2005). *Qualitative interviewing: the art of hearing data*. Thousand Oaks, CA: Sage.
- Ruppert, S. (1996). *The politics of remedy: State legislative views on higher education*. Washington, DC: National Education Association.
- South Carolina Commission on Higher Education. (2012, January). *Information on Higher Education and FY 2012-13 Priorities for presentation to SC House of Representatives Ways and Means Committee*. Retrieved September 12, 2012 from: <http://www.South%20Carolina%20Commission%20on%20Higher%20Education011912.pdf>
- South Carolina Commission on Higher Education. (2012). *2012 Session Summary Update for Higher Education*. Retrieved August 19, 2012 from: http://www.che.sc.gov/InfoCntr/Legisl/2012_SessionUpdate_asof070612_rev7-25.pdf
- South Carolina Commission on Higher Education. (2011). *Leveraging higher education for a stronger South Carolina*. Retrieved July 21, 2010 from: http://www.che.sc.gov/HigherEd_ActionPlan.htm
- South Carolina Commission on Higher Education. (2007, June 12). *Garrison Walters Named Executive Director of the South Carolina Commission on Higher Education*. Retrieved October 6, 2012 from: http://www.che.sc.gov/InfoCntr/PressRelFiles/Walters_Announcement_061207.pdf
- South Carolina EPSCoR/IDeA. (2012). *About Us*. Retrieved October 1, 2012 from: <http://www.scepscoridea.org>
- South Carolina Governor's School for Science and Mathematics. (2012). *Support GSSM*. Retrieved October 7, 2012 from: <http://www.wcgssm.org>
- South Carolina INBRE. (2012). *About Us*. Retrieved October 1, 2012 from: www.scinbre.org
- South Carolina Independent Colleges and Universities. (2012). *Who we are*. Retrieved October 2, 2012 from: www.scicu.org
- South Carolina Personal Pathways. (2012). *How it works*. Retrieved October 6, 2012 from: www2.scpathways.org
- South Carolina State Board for Technical and Comprehensive Education. (2011, September 15). *Fiscal Year 2010-2011 Accountability Report*. Retrieved October 1, 2012 from: www.sctechsystem.edu

- Southern Regional Education Board. (2010). *No Time to Waste: Policy Recommendations for Increasing College Completion*. Retrieved September 26, 2012 from: http://www.sreb.org/page/1456/degree_completion.html
- State Higher Education Executive Officers. (2012). *State Higher Education Finance: FY 2011*. Retrieved October 6, 2012 from: http://sheeo.org/finance/shef/SHEF_FY11.pdf
- Squire, P. (2007). Measuring state legislative professionalism: The squire index revisited. *State Politics and Policy Quarterly*, 7, 211-227.
- Squire, P., & Hamm, K.E. (2005). *101 Chambers: Congress, state legislatures, and the future of legislative studies*. Columbus, OH: The Ohio State University Press.
- State of Georgia. (2011). *Stimulus accountability*. Retrieved June 6, 2011 from: http://www.stimulusaccountability.ga.gov/00/channel_press/0,2684,134245182_151134394,00.html
- State of South Carolina. (2011). *Federal stimulus tracking*. Retrieved June 6, 2011 from: <http://www.stimulus.sc.gov/projects/>
- State of South Carolina. (2011). *Code of Laws*. Chapter 59 – Education. Retrieved October 2, 2012 from: <http://www.scstatehouse.gov/code/t59c103.php>
- State of Tennessee. (2011). *First to the Top*. Retrieved June 6, 2011 from: <http://www.tn.gov/thec/Divisions/fttt/fttt.html>
- State of Tennessee. (2009, May 13). *Recovery Act Funds to Power Comprehensive Economic-Development Program*. Retrieved September 8, 2012 from: <http://news.tn.gov>
- STEM Connector. (2012). *STEM Directory*. Retrieved September 8, 2012 from: www.stemconnector.org
- Tennessee Board of Regents. (2012). *TBR Board Members*. Retrieved September 8, 2012 from: <http://www.tbr.edu/about/default.aspx?id=508>
- Tennessee Department of Education. (2012). *Tennessee Diploma Project*. Retrieved September 9, 2012 from: www.tn.gov/TDP
- Tennessee Department of Education. (2010). *First to the Top Act of 2010*. Retrieved August 19, 2012 from: <http://tn.gov/firsttothetop/docs/First%20to%20the%20Top%20Act%20of%202010.pdf>
- Tennessee Higher Education Commission. (2012). *Tennessee's Outcomes-Based Funding Formula*. Retrieved September 8, 2012 from: <http://www.state.tn.us/thec/>
- Tennessee Higher Education Commission. (2010). *The Public Agenda for Tennessee Higher*

- Education: 2010-2015*. Retrieved July 1, 2012 from: http://tn.gov/thec/complete_college_tn/ccta_files/master_plan/The%20Public%20Agenda%20with%20Appendices%20Jan2011.PDF
- Tennessee Higher Education Commission. (2010). *Complete College Tennessee Act*. Retrieved on August 15, 2012 from: http://tn.gov/thec/complete_college_tn/ccta_files/ccta/Pub%20Chap%203%20-%201st%20Ex%20Sess.PDF
- Tennessee Higher Education Commission (2010, August 17). *Race to the top opportunities*. State of Tennessee Higher Education Commission. Retrieved July 17, 2011 from: <http://www.tn.gov/thec/Divisions/fttc/documents/Race%20to%20the%20Top%20Memo.pdf>
- Tennessee Independent College and Universities Association (2012). *About TICUA*. Retrieved September 1, 2012 from: <http://www.ticua.org/about/about>
- Tennessee Economic and Community Development. (2006, June). *Tennessee Innovation Road Map: Building Tennessee's Technology Economy*. Retrieved September 8, 2012 from: www.tnepscor.org
- Tennessee Stem Innovation Network. (2012). *About the Tennessee STEM Innovation Network*. Retrieved September 8, 2012 from: <http://tsin.battelle.org/>
- Tennessee Stem Leadership Academy. (2012, June 26). *Tennessee Solar Conversion and Storage Using Outreach, Research, and Education: TN-SCORE*. Retrieved September 8, 2012 from: www.tnepscor.org
- The State. (2012, July 17). *Results: House and senate votes and notes on Haley vetoes*. Retrieved online October 7, 2012 from: <http://www.thestate.com/2012/07/17/2357265/general-assembly-veto-override.html>
- The State. (2010, December 10). *Mark Sanford: Legacy*. Retrieved October 6, 2012 from : <http://www.thestate.com/2010/12/11/1601923/mark-sanford-legacy.html>
- The State. (2010, December 10). *Mark Sanford: Legislature*. Retrieved October 6, 2012 from: <http://www.thestate.com/2010/12/11/1601786/mark-sanford-the-legislature.html>
- The State. (2010, April 18). *Barker: Federal investments helping Clemson meet strategic goals*. Retrieved July 16, 2011 from: <http://www.thestate.com/2010/04/11/1247013/barker-federal-investments-helping.html#storylink=misearch>
- The State. (2011, May 25). *S.C. won't compete for 'Race to the Top' education money*. Retrieved July 17, 2011 from: <http://thestate.com/2011/05/25/1834012/sc-wont-compete-for-race-to-the.html>
- The State. (2011, January 19). *Gov. Haley's state of the state address*. Retrieved July 16, 2011 from: <http://www.thestate.com/2011/01/19/1653827/gov-haleys-state-of-the-state.html#storylink=misearch#ixzz1SHTqNvFI>

The State. (2011, May 25). *S.C. won't compete for 'Race to the Top' education money*. Retrieved July 16, 2011 from: Read more: <http://www.thestate.com/2011/05/25/1834012/sc-wont-compete-for-race-to-the.html#ixzz1SHWgFRab>

The State. (2010, March 4). *South Carolina tapped as finalist in heated federal Race to the top grant competition*. Retrieved online August 22, 2012 from: <http://ed.sc.gov/agency/news/?nid=1451>

University System of Georgia. (2007, June 13). *USG working to ramp up math/science education and production of math/science teachers*. Retrieved November 4, 2012 from: http://www.usg.edu/news/release/usg_working_to_ramp_up_math_science_education_and_production_of_math_scienc

University System of Georgia. (2011, November). *Consolidated funding formula presentation*. Retrieved November 18, 2012 from: http://www.usg.edu/fiscal_affairs/documents/Consolidated_Formula_Presentation_-_November_Board_-_Final.pdf

University System of Georgia. (2011,). *Complete college Georgia: Georgia's higher education completion plan 2012*. Retrieved online November 19, 2012 from: http://www.usg.edu/educational_access/documents/GaHigherEducationCompletionPlan2012.pdf

University System of Georgia. (2012). *USG STEM initiative*. Retrieved November 4, 2012 from: http://www.usg.edu/educational_access/documents/STEM_Initiative.pdf

University of Tennessee. (2012). *About Us*. Retrieved September 8, 2012 from: <http://www.tennessee.edu/>

University of Tennessee. (2010). *Consortium of Tennessee universities receives \$20 million grant from the national science foundation*. Retrieved October 21, 2012 from: http://www.tennessee.edu/media/releases/090910_epscor.html

USA Today. (2009, March 15). *Governors reject stimulus money for unemployment*. Retrieved October 7, 2012 from: http://usatoday30.usatoday.com/news/nation/2009-03-15-unemployment_N.htm

U.S. Department of Education. (2010. August 24). *Nine states and District of Columbia win second round Race to the Top grants*. Retrieved July 20, 2011 from: <http://www.ed.gov/news/press-releases/nine-states-and-district-columbia-win-second-round-race-top-grants>

U.S. Department of Education. (2009, November 2). *American Recovery and Reinvestment Act report: Summary of programs and state-by-state data*. Washington, D.C: U.S. Department of Education.

- U.S. Department of Education. (2009, November). Race to the top fund – executive summary. Washington, D.C.: U.S. Department of Education.
- Volkwein, J.F., & Tandberg, D.A. (2007). Measuring up: Examining the connections among state structural characteristics, regulatory practices, and performance. *Research in Higher Education*, 49, 180-197.
- Walker, J. L. (1969). The diffusion of innovations among the American states. *American Political Science Review*, 63, 880-899.
- Wall Street Journal. (2009, March 21). *Why South Carolina doesn't want 'stimulus'*. Retrieved online October 7, 2012 from: <http://online.wsj.com/article/SB123759827524401409.html>
- Walters, Garrison. (2008). *South Carolina Commission on Higher Education Graduate/Professional Initiative*, 3.
- Weerts, D. & Ronca, J. (2006). Examining differences in state support for higher education: A comparative study of state appropriations for research I universities. *Journal of Higher Education*, 77(6), 935-967.
- Yamaner, M. (2011, July). *Federal funding of basic and applied research increases in FY 2009*. Retrieved October 31, 2011 from <http://www.nsf.gov/statistics/infbrief/nsf11324/>
- Yin, R.K. (2009). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.
- Zumeta (1996). Meeting the demand for higher education without breaking the bank: A framework for the design of state higher education policies for an era of increasing demand. *Journal of Higher Education*, 67, 367-425.

APPENDIX A

GLOSSARY OF ACRONYMS

ARRA	American Recovery and Reinvestment Act
CHE	Commission for Higher Education
CIC	Council for Independent Colleges
CCTA	Complete College Tennessee Act
COBRE	Centers of Biomedical Research Excellence
DOE	Department of Education
EPSCoR	Experimental Program to Stimulate Research
GICA	Georgia Independent College Association
GRA	Georgia Research Alliance
IDeA	Institutional Development Awards
INBRE	IDeA Networks of Biomedical Research Excellence
MUSC	Medical University of South Carolina
NAICU	National Association of Independent Colleges and Universities
NASA	National Aeronautical Space Administration
NSF	National Science Foundation
ORNL	Oak Ridge National Laboratory
PSM	Professional Science Masters
RTTT	Race to the Top
TBR	Tennessee Board of Regents
TCSG	Technical College System of Georgia
THEC	Tennessee Higher Education Commission
TICUA	Tennessee Independent Colleges and Universities Association
TN-SCORE	Tennessee Solar Conversion and storage using Outreach, Research, and Education
TNCRED	Tennessee Consortium on Research, Evaluation, and Development
TSIN	Tennessee Stem Innovation Network
USG	University System of Georgia
UT	University of Tennessee
UTK	University of Tennessee at Knoxville

APPENDIX B

HIGHER EDUCATION STRUCTURE

State	Governing Board	SHEEO Officer	Institutions
Georgia	University System of Georgia	Henry “Hank” Huckaby, 2012 - present	Oversight for 31 colleges and universities
	Technical College System of Georgia	Ron Jackson, 2008 - present	Oversight for 25 technical colleges and 31 satellite campuses
Tennessee	Tennessee Higher Education Commission	Dr. Richard Rhoda, Chief Operating Officer, 1997 – present	Oversight for TBR and University of Tennessee System
	Tennessee Board of Regents	John Morgan, Chancellor, 2010 - present	6 colleges/universities 13 community colleges 27 technology centers
	University of Tennessee System	Dr. Joe DiPietro, University of Tennessee President, 2011 - present	4 campuses Extension and public service units
South Carolina	South Carolina Commission for Higher Education	Vacant	Oversight for 17 colleges/universities
	University of South Carolina System	Dr. Harris Pastides, 2008 - present	8 campuses

APPENDIX C

INTERVIEW PROTOCOL

Before we get started, I just want to be sure you are fine with me recording this interview and ask what your preference is for how I identify you in my dissertation. Do you prefer for me to use a pseudonym, position title, or your name when I write up my analysis in my dissertation?

I thought it might be helpful to first give you a brief overview of my focus for the study. As you read in my initial inquiry letter, I'm interested in learning about how STEM innovations rise to the state higher education governing boards agenda. I have identified three states based on their initial bid for RTTT funding in phase 1 to see if the influence of federal funding during a period of economic recession influenced the direction that states took for their STEM innovations after this point up until 2012. I'm also looking at what role (if any) the higher education agency played in the initial RTTT application and what additional factors may have influenced the direction taken with STEM innovations in higher education within your state. As you know, the RTTT grant criteria required states to identify partners with STEM innovations including industry, higher education institutions, and research centers. So, while RTTT is one of my selection criteria, my primary focus is on what happened in your state between 2007-present related to see if RTTT or any other external influences shaped the direction taken with STEM innovations.

1. Could you provide an overview of how [state], made the decision to apply for the first round of Race to the Top grant funds in 2007?
2. In this first round, are you aware of who the major players were in deciding what STEM innovations should be included in the grant proposal?
3. Why did [state] choose the emphasis on the STEM innovations that it did?
 - a. Was there a perceived problem in the state that motivated the innovation?
 - b. How did ARRA funding encourage particular STEM policy initiatives?
 - c. What role did the higher education agency play in the process?
 - d. What role did specific universities/colleges play? (Did privates play a role?)
4. What role did other external factors have on the outcome?
 - a. How much autonomy do you feel the state had in selecting the STEM innovations it did for the RTTT grant?
 - b. Were there national standards that put pressure on state/ state higher education agency to conform?
 - c. Were there political factors that played a role? If these factors changed, do you think the outcome would have been different?
 - d. What associations are you/state a member of and what ideas did you/state get from these associations?
5. Outside of what [state] did for the RTTT grant, what other STEM policies were being considered between 2007-2012?
 - a. What type of information was considered when looking at these innovations?

- b. Did South Carolina consider what state neighbors were doing related to ARRA/RTTT when deciding what direction to take with STEM innovations?
 - c. Did the state master plan dictate the direction of innovations?
- 6. How did various state-level organizations influence this process?
 - a. What role did the higher education agency play?
 - b. Were there policies and practices already in place that made particular STEM innovations rise to the state higher education agency agenda?
 - c. Did the major policy leaders receive feedback that reinforced particular innovations?
 - d. Did members within a particular organization provide input or prompt shifts in practice?
- 7. South Carolina and Georgia Only: I did review [state's] second phase application for RTTT: Are you aware of how the second application changed and what influenced those changes? Were there any additional discussions involving the [state higher education governance organization] between the two applications?
- 8. South Carolina: I read newspaper articles where Governor Haley stated SC would not seek out further RTTT funding. Can you comment on why SC took this position? Who was involved in making these decisions?
- 9. Is there anything else that you would like to add that perhaps I didn't ask you about, but that you feel is relevant to my research?
- 10. Part of my research technique is to ask interviewees for any additional names of people who they think could be beneficial to my research. Do you have any recommendations for me?

APPENDIX D

ANALYTIC FRAMEWORK

Table 3: Network Pressures that Influenced STEM Innovations.

	South Carolina	Georgia	Tennessee
National Standards, Networks, or Organizational Pressures which Influenced STEM Innovations	<p>SREB – GreenSTEM (3)</p> <p>Common Core Standards (3)</p> <p>National Academies, STEM Coalition (1)</p> <p>Science and Mathematics Teacher imperative (1)</p> <p>SHEEO Meetings (1)</p> <p>Gates and Lumina initiatives (1)</p> <p>STEM partnerships with other research universities outside of state through federal programs (1)</p> <p>National Governors Association (1)</p> <p>Heritage Foundation (1)</p> <p>EPSCoR state (1)</p>	<p>Funding from non-profits:</p> <p>a. Gates Foundation as awarded funds for consultant (3)</p> <p>b. Parthenon consulting group (3)</p> <p>c. NSF Mathematics and Science Partnership Program/PRISM (3)</p> <p>d. Lumina</p> <p>National Governors Association (3)</p> <p>Teach for America (3)</p> <p>New Teacher Project (3)</p> <p>UTeach (2)</p> <p>Georgia Performance Standards/Professional Standards Commission (2)</p> <p>Common Core Standards (1)</p> <p>National Council of Teachers of Mathematics (1)</p> <p>Diploma Project (1)</p> <p>SREB (1)</p>	<p>Funding from non-profits:</p> <p>a. Gates Foundation awarded funds for consultant (3)</p> <p>b. Education First consulting group (3)</p> <p>c. Lumina (2)</p> <p>d. Sloan Foundation for PSM program (1)</p> <p>Complete College America (6)</p> <p>Oak Ridge National Laboratory</p> <p>a. Battelle partnership with ORNL and UTK (3)</p> <p>b. ORNL research & funding from U.S. Dept. of Energy (1)</p> <p>TICUA/Vanderbilt participation in state initiatives (4)</p> <p>Common Core Standards (3)</p> <p>Diploma Project (3)</p> <p>EPSCoR state (2)</p> <p>ARRA funding (2)</p> <p>UTeach (2)</p> <p>STEM X member (1)</p>

		Complete College (1) Georgetown Studies (1) Governors Competitive Workforce Agenda (1) MESA (1) Achieve (1)	College and Career Ready Policy Institute (1) Council of Graduate Schools (1)
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Table 4: Influence of RTTT Incentives on STEM Innovations.

	South Carolina	Georgia	Tennessee
Influence of RTTT incentives on STEM Innovations	<p>Would have connected innovations going on within the state (1)</p> <p>Charter reform bill (1)</p> <p>Multi-lateral collaborations between institutions did not occur/Institutions working on their own (2)</p> <p>Legislature did not have any initiatives (1)</p> <p>Clemson partnership with technical colleges (1)</p>	<p>Innovation Fund connected CEISMC/GA Tech to schools (3)</p> <p>Accelerated work already underway – PRISM and USG STEM Initiative (2)</p> <p>UTeach part of Grant (2)</p> <p>Tied to charter school initiatives (1)</p> <p>No ties to other ARRA funded projects (1)</p>	<p>Connected innovations going on within the state/ Recruitment of STEM related industries (4)</p> <p>STEM Education Reform/Teacher Prep (2)</p> <p>Funding to move more quickly on initiatives already underway (2)</p> <p>Through UTeach - Development of STEM hubs (2)</p> <p>STEM X membership (1)</p> <p>First state to sign on with Battelle as a partner in RTTT – other states emulated in round 2 and 3 of RTTT (1)</p>

			Univ. of Memphis: CRISTAL STEM research lab (1)
			Catalyst for Program/Innovation Development (1)
			Membership in PARCC (1)
			Addressed Common Core Standards project (1)
			Complete College TN Act and membership in Complete College America program (1)
			Statewide STEM advisory board (1)

Table 5: Influence of regional neighbors and ideological similarities.

	South Carolina	Georgia	Tennessee
Influence of regional neighbors and ideological similarities	Ohio with K-12 (3) Texas (3) North Carolina (2) Virginia (2) Kentucky (2) Georgia/USG (2) Look nationally (2) Florida (1) Wisconsin (1) Colorado (1) Arizona (1) Washington (1) New Jersey (1)	Ohio (3) Texas (3) Tennessee (2) Louisiana (1) Florida (1) North Carolina (1) Oklahoma (1) Colorado (1)	Texas (5) Ohio (5) Kentucky (3) Look nationally (3) North Carolina (2) Feel TN is the leader (2) Georgia (1) Look internationally (1)

Table 6: Interactions between state leaders within a region.

	South Carolina	Georgia	Tennessee
Interactions between state leaders within a	SREB - GreenSTEM initiative (1)	SREB (1)	Diploma Project, Achieve, Education

region		<p>Diploma Project and Complete College America membership gave them access to data and best practices among leaders (1)</p> <p>Governor intentionally did not involve associations in RTTT program proposal planning to limit influence (1)</p>	<p>Trust, and Education Delivery Institute, and Complete College America membership gave them access to data and best practices among leaders (4)</p> <p>Education First had connections with Ohio/Battelle (1)</p>
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Table 7: Perception of competition with neighboring states for resources.

	South Carolina	Georgia	Tennessee
Perception of competition with neighboring states for resources	Nothing mentioned	Nothing mentioned	Nothing mentioned

Table 8: Standardized Rules, Processes, or Expectations.

	South Carolina	Georgia	Tennessee
Standardized rules, processes, or expectations that may indicate the role of institutionalized practice on what STEM innovations were further advanced	<p>SC's Education and Economic Development Act (2)</p> <p>SmartState program (2)</p> <p>Palmetto Fellows and Life Scholarship program (3)</p> <p>Personal Pathways to Success (1)</p> <p>SC Code of Law: Critical success factors and performance indicators (1)</p>	<p>NSF MSP funding which led to USG STEM Initiative (4)</p> <p>Previous work of Georgia Tech through CEISMC (4)</p> <p>Governor's Strategic Plan (2)</p> <p>HB 280, STEM teacher differentiated pay (2)</p> <p>Innovation Fund administered through Governor's Office of Student Achievement</p>	<p>Executive Order No. 68 establishing TN STEM Innovation Network (1)</p> <p>American Diploma Project work began in 2007 (1)</p> <p>Complete College Tennessee Act in 2010 (1)</p> <p>EPSCoR grant: TN-SCORE (1)</p> <p>Previous work with Battelle through ORNL (1)</p>

	<p>State structure with Board of Education does not direct specific operations – outside influence is limited (1)</p> <p>NSF grant which led to S2Mart Initiative (1)</p>	<p>Professional Standards Commission (1)</p> <p>Charter friendly state (1)</p> <p>Right-to-work state (1)</p>	<p>Outcomes based funding formula (1)</p> <p>THEC public agenda (1)</p> <p>THEC supply-demand study (1)</p>
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