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THE CHALLENGES OF CHANGE:

SHOULD THE RATIONAL PLANNING MODEL USED IN
LONG RANGE TRANSPORTATION PLANNING BE REPLACED?

By

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And approved by

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ABSTRACT OF THE DISSERTATION

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This dissertation provides a critique of state level long range transportation planning in the United States within the context of regulation. The research identifies challenges faced by state level planners and how historical, organizational, and methodological constructs have undermined quality outcomes. Recommendations are suggested on how to modify traditional reductionist rational long range transportation planning practice in order to increase the probability of creating more effective and robust transportation policies.

The research is composed of three parts: a case study of the Delaware Department of Transportation (DelDOT), an analysis of current individual state long range transportation plans, and a phone survey of DOT directors of transportation planning directly responsible for their respective state’s long range transportation plan (LRTP) development.

The research found that state level long range transportation plans over the past 40 years have been created to meet statutory federal requirements for funding rather than
as a tool for improving the quality of transportation policy outcomes. The process has led to little motivation to implement improved long range planning methodologies since the results of the plans have not actually been utilized in practice. The perception of planners and other stakeholders is that state level long range transportation planning has lost salience and is of little utility under a Federal regulation policy of “one size fits all.” The interviews and case study affirmed continuing semantic and philosophical divides between transportation engineers, planners, and the public, thus limiting new insights and creativity. Epistemological challenges coupled with a pervasive “that’s the way we have always done it” view appears to have hindered any desire for change in historical long range planning practice within state transportation agencies due to undefined risks in challenging the status quo.

The research presented demonstrates how existing federal-state long range transportation planning processes can be altered to better inform policy development by using alternative “mindful” analytic and behavioral methodologies. Salient approaches better suited to policy development for complex chaotic systems, should contribute to greater robustness, resilience and sustainability of desired future outcomes so the resulting plans do not continue to remain just another “unused document on the shelf.”
Acknowledgements and Dedication

This work is dedicated to all the people in my life’s journey that have contributed in so many ways to help me be a better person and achieve my dreams. Thank you.

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1.1 Introduction

Returning to transportation planning after a 35 year absence, I observed that long-range planning methodologies employed at the state level appeared to lag behind what I had experienced in the private sector involving multi-criteria and multi-attribute decision making. The planning approaches utilized by State Departments of Transportation (DOTs) seemed to rigidly adhere to reductionist single point estimate rational planning models (RPM) of predict-then-act that were inherently weak in their capacity to prioritize and value long-term policy recommendations given the actual conditions of very significant risk and deep uncertainty about future outcomes. Without regard to their capabilities, there appeared to be no shortage of quite sophisticated analytical models that attempted to forecast *single point estimates* of future transportation demand, capacity, service levels, asset life, economic effects and environmental impacts. These models assumed distributions of inputs and outcomes, costs and benefits where there was virtually no degree of certainty or agreement as to their values, resulting in artificial and misleading assumptions of precision and accuracy. There also appeared to be a dearth of effective capability on how to value and prioritize policy options based on those single point estimates, regardless of their forecast validity. Consideration of risk and uncertainty was functionally absent in most state long range transportation plans sans the statement that a *lack of funding* was the principle “risk.” The focus of the plans seemed more on *how, when and where* to build physical projects primarily based on
techno-centric problem solving criteria driven by linear extrapolation of the past. There was little or no serious evaluation of the salience of the underlying validity for the historical assumptions upon which future strategic policy options were being selected.

There also was apparent cognitive constriction and rigidity of thinking and narrowness of focus. “That’s the way we have always done it” was a frequent refrain heard from state and federal transportation planners, engineers and managers when challenged as to the why of utilizing a particular problem definition or solution methodology. There were semantic and epistemological inconsistencies in both state and federal policies within the long range planning process. Was long range transportation planning a natural science or a social science? “Best practices” was a frequently used term with little or no measure of what “best” was, and alternatively might have been described as “least worst practices.” Were these observations simply unsupported judgments, or was there a chronic problem limiting the quality and creativity in long range transportation policy planning at the state level? If there was a problem, was it widespread, or unique to just a handful of state DOTs?

A review of the academic and practice literature suggested that disciplines in differing social and physical sciences had perhaps progressed faster than state level transportation planning in migrating more creative planning philosophies into practice, and implementing methodologies that better informed the prioritization and value of long-range policy options given significant future risk and deep uncertainty. If improved methodologies in long-range transportation planning and prioritization at the state practice level were not being adopted as in other disciplines; why was this the case? Had the quality of US transportation policy outcomes therefore suffered over time? Were
changes needed, and if so, how should they be accomplished? On what basis should future transportation policy options be considered, valued and prioritized? Just how long (or short) should a long range transportation plan be to be effective? Did problems in framing the “best” policy solutions stem from limitations within practitioners, organizational structures, methodologies, planning horizons, a combination of these factors, or some other heretofore unknown elements?

1.2 Hypothesis and Research Questions

Based on my observations and preliminary literature review I hypothesized that improved methodologies might be inhibited by institutional and/or organizational structures that were not conducive to new methodological change. A further review of the literature lead to four research questions being formulated:

a. What are current practices in transportation forecasting and planning?

b. How, if at all, have practices changed over the last five decades?

c. What factors are responsible for the current state of practice? (Federal/state regulation and requirements, staff training, etc.)

d. What factors could change current practice? (such as altered federal/state requirements, exogenous factors as budgets and climate change creating pressure on federal and state DOTs; and changes in educational practices, such as postgraduate continuing education)
Although the initial research focused primarily on analytical methodologies, it quickly became apparent that institutional provincialism, ethnographic, and philosophical considerations in the long-range transportation planning process were at least as significant, and perhaps even more significant, in affecting methodology implementation and policy quality then just the “math.” The research was divided into three components; a case Study of the Delaware Department of Transportation, a review of 50 State Long Range Transportation Plans (SLRTPs), and structured phone interviews of State Directors of Transportation Planning. Each research component approached the issues with a different methodological view but under the umbrella of an ethnography perspective. The qualitative ethnographic perspective in combination with other more traditional quantitative research methods were employed to help prevent the research itself from falling prey to the limitations of reductionist bounded rationality analyses.1

1.3 Thesis Research Justification

GAO testimony to the US Senate in July of 2008 stated that government policy continues to use approaches and priorities that were established decades ago and not appropriate to 21st century challenges in surface transportation (GAO-09-868, 2009). The States and Federal Government continue to forecast future transportation infrastructure needs using methods based on the reductionist linear Rational Planning Model (RPM) of predict-then-act (Giuliano, 2007). The Rational Planning Model is a deterministic linear decision making approach generally composed of five steps: 1) identify an objective or goal, 2) identify alternatives to achieving the goal or objective, 3)

1 The author was an employee of the Delaware Department of Transportation from October 2007 to October 2012 as both an observer and participant within the planning culture during the initiation of the dissertation research.
predict the results for selecting each alternative, 4) compare and contrast the results, and 5) prioritize and select the “best” alternative based on a success criteria (Khisty and Arslan, 2005). The identified problem to be solved is then further broken down into ever smaller components (reductionism) to facilitate analysis under the significant, and many times incorrect assumption, that salience is not lost in the reduction process.²

The RPM approach has proven reasonable in solving problems that are well defined and bounded, have unity of objective and are without the dimensions of significant risk, uncertainty, value ambiguity and future time. Numerous research studies have demonstrated that the reductionist RPM approach fails when applied to long-range planning of complex systems under conditions of deep uncertainty and risk (Lempert, 2006). Surface transportation in the United States has become a highly complex multi-modal network in the last 100 years with over 4.05 million miles of public roads with 603,245 bridges serving 3.0 trillion vehicle miles of travel, 170,000 miles of railroad track, 25,000 miles of navigable waterways, 172,048 miles of oil pipelines and 1,540,000 miles of gas pipelines (United States Bureau of the Census, 2012).

The U.S. highway system in particular has undergone dramatic changes in scale, scope, and utilization since 1904 when the automobile was considered a pleasure vehicle and not a serious method of transportation (Weiner, 1992). At the state and federal practice level long-range transportation planning appears to reflect its heritage rather than its future. The potential for squandering limited resources both physical and financial, increased environmental damage and greater future societal burden increases when the

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² The poem “The Blind Men and the Elephant” by John Saxe (1816-1887) is frequently used to demonstrate by analogy the loss of saliency with reductionism. Six blind men each perceive by only touch a different part of an elephant and all are partially correct in their description, but completely wrong in total; describing the elephant as being like a wall, spear, snake, tree, fan or rope.
use of outdated transportation planning methods lead to potentially flawed future policy conclusions (Oades and Dimitriou, 2006). The National Transportation Policy Project argued that “National transportation policy has lost direction and a clear sense of purpose, threatening substantial costs to our collective prosperity, security, environment, and quality of life (NTPP, 2009).” A USGAO report in 2009 also supported this observation:

“Despite more than 30 years of federally mandated and funded transportation planning process and billions spent on roads, bridges, and transportation projects, there is not enough information for policy makers to determine whether the planning process is addressing critical transportation challenges facing the United States” (USGAO-09-868, 2009).

With the potential expenditure of over 11 trillion dollars on transportation infrastructure in the United States over 50 years (NSTPRSC, 2007), facing a half trillion dollar short fall in funding in six years (AASHTO, 2012), and currently under spending by an estimated $47 billion per year what is needed every year for the next 20 years (USDOT, 2013) to maintain existing infrastructure in a state of good repair, it is perplexing that planning methodologies at the state practice level continue to extensively use the single point estimate Rational Planning Model of predict-then-act when it has been shown to be ineffective (Khisty, 2005). The predict-then-act approach can be effective in the shorter term of the planning spectrum where project management is employed and applied to physical processes that have deterministic long term outcomes; yet still permit changes in priorities, costs and technologies over time (Crossney, Mayer and Greenberg, 2007). In contrast, particularly during the last 40 years, alternative long-range planning and policy analysis methodologies employing multiple-criteria and multi-attribute decision theories have been adopted in physical infrastructure, military, and social science venues where long term outcomes are not deterministic. That evolution
continues and has been rather dramatic in certain instances, although perhaps not complete. These alternative techniques have demonstrated improved capabilities to deal with the conditions of complexity, deep uncertainty, risk, human behavior and subjective values yielding improved insights into how to develop more robust and resilient policies than using traditional reductionist RPM methodologies as employed in short term project management (Finkel, 1994; Metlay, 2014; Shiau and Liu, 2012; Awasthi and Chauhan, 2011).

One of the multiple-criteria and multiple-attribute methodological approaches to prioritization that incorporates both quantitative and qualitative value considerations in a structured format is the Analytical Hierarchy Process (AHP) developed by John Satty (Satty, 1980). Utilization of AHP in practice has been growing at a faster annual rate than other multiple-criteria and multiple-attribute decision making approaches since the early 1990s (Wallenius, et. al. 2008). One consideration of the dissertation research is that AHP appears to be a highly underutilized and almost non-existent decision making tool in US long range transportation planning.³ If employed as part of the transportation planning process AHP might contribute to improved quality in policy development, and improve outcomes through its more structured facilitation of stakeholder perspectives. This approach might help improve participant insights into the trade-offs of optimal versus desired robust outcomes given uncertain futures. A description of the theoretical

³ There are examples in the USDOT literature where AHP has been utilized for transportation problems in the selection of alternatives for bridge and facility maintenance, and mode/route selection, etc. However the problems being modeled are very short range, highly bounded in scope and engineering focused (materials trade-offs, least cost routing, etc). See http://search.usa.gov/search?utf8=%E2%9C%93&affiliate=dot-fhwa&query=AHP&commit.x=19&commit.y=11. (accessed 08-03-2015).
construct of AHP is contained in Appendix D and the real life application in Chapter 4: The DelDOT case study.

The knowledge of techniques more advanced and successful than the reductionist RPM approach, including AHP for long-range transportation infrastructure planning, has existed for many years within the academic community (Rodier, 2007). These approaches, however, appear not to have migrated into the practice for long range transportation planning at the state level to the same degree as evidenced in other disciplines’ migration of planning techniques from academic theory into practice. Edward Weiner concluded that:

“During the 1970s, new travel forecasting techniques were developed for the most part by the research community, largely in universities. These disaggregate travel forecasting approaches differed from the aggregate approaches being used in practice at the time. They used new mathematical techniques and theoretical bases from econometrics, and psychometrics that were difficult for practitioners to learn. Moreover, the new techniques were not easily integrated into conventional planning practices. Communications between researchers and practitioners was fitful. While researchers were developing more appropriate ways to analyze this complex array of issues and options, practitioners remained wedded to the older techniques.” (Werner 1999, page 217)4

Perhaps long range transportation planning represents the most extreme example of a large scale multi-dimensional, multi-criteria techno-human system of systems that can be described as a “messy problem” (Ackoff, 1970) and/or a “wicked problem” (Ritter and Webber, 1973).5 Perhaps transportation’s messy/wicked problem is sui generis and that is why more advanced planning methodologies, such as AHP and others, as utilized

4 The dissertation interviews of State Directors of Transportation Planning some 40 years after Werner’s observations about the 1970’s state level transportation planning environment indicated that the planning environment remained substantially unchanged.
5 A messy and/or wicked problem primarily has no definite formulation, no stopping rule, is not true or false but good or bad, has no immediate or ultimate test of a solution, every problem is a symptom of another problem, and the social planner has no right to be wrong; every solution counts, no trial and error.
in other professions have not migrated into long range transportation planning practice. Hence the reason for this research effort.

In particular, why has planning at the state level not evolved in a commensurate fashion to meet the greater policy challenges posed by a system that has so dramatically increased in complexity? If the RPM approach to long range planning in transportation is thought to be inferior, why has it continued to be used? This is especially true over the last twenty years where the additional complexity of sustainability, resilience and climate change is becoming part of the transportation infrastructure policy equation. Planning horizons in land use and environmental disciplines have been evolving from several years to greater than 100 years in many situations. If transportation long range planning methodology is already thought to be ineffective at a federally prescribed minimum 20 year planning horizon as required by 23 CFR 450.214-b-2, how will it fare at 100 years or more? Can transportation policies developed under an acknowledged ineffective methodological approach be sustainable, and by definition meet the needs of the present population without compromising the ability of future generations to meet their own needs? The research I conducted attempts to answer these questions and recommends possible improvements in the long range state transportation planning process that better informs policy development. The dissertation chapters reflect the sequence of how the original research was performed.

Chapter 2 is a broad literature review of rational planning evolution, a condensed history and critique of highway long range planning and analysis in the United States, and an overview of multi-criteria and multi-attribute decision making and planning methodologies given deep uncertainty and risk.
Chapter 3 describes how the research process was conducted and the analysis methodologies selected. Chapter 4 is a case study of the Delaware Department of Transportation (DelDOT) with a special focus on the performance of that agency’s trial implementation of the Analytical Hierarchy Process (AHP) as a replacement of its older isolated “weight and rate” prioritization process.\(^6\)

Chapter 5 is a brief review and structural analysis of the 50 State Long Range Transportation Plans (LRTP). Chapter 6 presents the results of the interviews conducted with the State Directors of Transportation Planning on long range planning topics covering:

- Process and organization considerations in planning
- Perceptions of long range planning by other agency staff, the public, and value as a decision making tool.
- Detailed considerations of specific planning methodologies
- Demographic and reference information on the respondents.

Chapter 7 is a summary of the findings and conclusions developed from the research data with policy recommendations and future research considerations.

\(^6\) Weight and rate is a project prioritization approach where assumptions are made as to the scaled individual decision criteria without challenging each against each other individually to arrive at a ranked order. Weights are then multiplied by rating values of criteria importance for each project or program under consideration and summed, resulting in a ranked order.
2.1 Reductionist Rational Planning: Definition, History and Context

The word "rational" derives from the Latin word "ratio," which means reason or computation. Merriam-Webster (Franklin Language Master 1993) defines “rational” as having reason or understanding. Reductionism in science is an investigative approach which looks at smaller spatial scales or organizational units to understand the larger whole. The reductionist single point estimate Rational Planning Model (RPM) as defined by Khistry and Arslan is a deterministic linear decision making model composed of five steps:

1) Identify an objective or goal
2) Identify alternatives to achieving the goal or objective
3) Predict the results for selecting each alternative
4) Compare and contrast the results
5) Prioritize and select the “best” alternative based on success criteria

(Khistry and Arslan, 2005)

Figure 1 depicts the typical architecture of the evolution of the rational planning model philosophy: it accepts the scientific method (objective science), research is based on empirical evidence that is value or bias free (positivism), and rational models are developed that explain phenomenon of interest, and the models are analyzed from ever
smaller component subset perspectives (reductionism) to arrive at solution. If the variables considered within long-range transportation planning were value free and completely certain, the policy process would become a mechanical exercise and fit the reductionist RPM philosophy perfectly; history has shown this not to be the case.

-FIGURE 1-

**Rational Planning Decision Process Flow**
From 1900 in its infancy, until just prior to WWII, the application of RPM single point estimate for highway infrastructure planning appeared to work well as problems were “reduced” to simple sets of vehicle movements and capacity characteristics. The circumstances did not have material future uncertainty and used a simple set of “rational” criteria for selecting the best alternative viewed as a Civil Engineering problem based on cost and physical capacity (Armstrong, 1976). This relative certainty was more easily achieved by not considering the attributes of environmental impact, social justice, transportation equity, sustainability, climate change, collaborative value and prioritization. There was no significant heightened awareness or general perceived need within the transportation discipline at that time to consider these social, environmental and sustainability factors. As time progressed surface transportation grew into a more complex system exhibiting emergent properties (non-linear and non-scalable characteristics). The sum of the parts became greater than the whole and you could not fully understand the transportation system from just examining smaller sub-sets (reductionism) and scaling them up (Garrison and Levinson, 2006). The assumption of infinite space availability to meet demand by continuously building more capacity started to reach physical land limitations and met with growing public resistance referred to as NIMBY-Not In My Backyard (Weiner, 1999).

Although questions started to be raised on how to better solve transportation problems, the domestic highway system grew into its adolescence in the mid 20th Century with long range planning still essentially a deterministic civil engineering “project building” oriented activity. The planning environment became far more complex and uncertain after WWII. Conflict in the risk and uncertainty of space, time,
physical and economic resources, social change, and goal prioritization accelerated. The development of operations research and systems engineering, advanced as a wartime necessity, began to transfer into public and private sector planning (Weiner, 1992).

Although these newer RPM analytical techniques drove greater efficiency improvements, they still had difficulty dealing effectively with incommensurable social and equity considerations, and the uncertainty and risk aspects of infrastructure policy development (Khisty and Arslan, 2005; Rittel and Webber, 1973; Thompson, et al., 1959).

The voices questioning the effectiveness of RPM grew louder after WWII. Herbert Simon in *Administrative Behavior* (1947) attacked its underlying assumptions in that it did not take into account the psychological and physiological limits of human decision makers. John Friedmann in *Retracking America: A Theory of Trans-active Planning* (1973) argued for a model based on collaboration, dialogue and societal action in a process of mutual learning. He declared in an APA editorial in 1993 of “the collapse of the Euclidian world order of stable entities and common sense assumptions that have governed our understanding of the world for the past two hundred years” (Friedmann, 1993). David Lewis in *The Future of Forecasting: Risk Analysis as a Philosophy of Transportation Planning* argued that:

“Forecasting in all fields today means accommodating a paradox of planning in an informed society, namely that the quest for certainty can foster indecision, whereas the exposure of doubt can promote resolution and action” (Lewis, 1995).

By the last quarter of the twentieth century the RPM model had evolved with additional “rationalities” and acquired the acronym SITAR representing five variations of rational planning: Synoptic, Incremental, Transactive, Advocacy and Radical
(Hudson, 1979). There are advocates and detractors for each and all combinations of SITAR. However, these reformulations still did not account for the issues of uncertainty, risk and value prioritization for policy options over time.

The alternative to rational planning is not necessarily irrational planning, although Paul Feyerabend in *Against Method* (1975) argued that science is an anarchistic enterprise and should not be run according to fixed and universal rules as this limits progress. A possible alternative to RPM is to restrict the use of RPM within its effective performance limits and consider Long Term Policy Analysis (LTPA). In LTPA multiple holistic plausible future contexts are considered and takes into account complexity, deep uncertainty and risk. Although not totally a Feyerabend approach it does enhance the incorporation of non-traditional, non-historically based rules-bending and may bring new perspectives and insights into the planning process. We may try to shape the transportation future for the betterment of society, but we cannot guarantee the outcomes.

Robert J Lempert in *Shaping the Next One Hundred Years: New Methods for Quantitative Long-Term Policy Analysis* (2003) defines deep uncertainty as

- where analysts do not know, or interested parties cannot agree on the appropriate conceptual models
- the distributions of the key parameters or variables are not fully known or understood
- the value or desirability of the alternative outcomes differs among stakeholders.

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7 Long Term Policy Analysis (LTPA), is a form of Scenario Analysis (SA). A key element of LTPA is that millions of scenarios are considered and not constrained by assumed initializing assumptions that may have inherent erroneous constraints due to planner biases or bounded rationality limitations. LTPA is a continuous and recursive process in search of evolving insights.
He reframes the objective of long range planning from “What will the long term future bring” to “How can we choose actions today that will be consistent with our long term interest?” (Lempert, et. al., 2003). The objective is not to achieve a single optimal answer based on a series of assumptions, but rather a topology of solutions that are part of a non-dominated set; that is, robust solutions that are highly adaptable and resilient to uncertainty and changing future conditions, and remain Pareto optimal (improving one circumstance does not degrade another).

In 1962 at the time of the enabling Federal legislation that set the current deterministic frame work for transportation planning and funding, the necessary computer capability and software for LTPA scale policy analytic analysis was not available within state DOTs. In the early 21st Century this is no longer the case. Federal and State departments of transportation operate in a deep uncertainty environment. Continued use of 1960’s era deterministic tools and processes for future policy development may by definition result in policy determinations that lack the flexibility and robustness to successfully respond to changing conditions except by random chance.

2.2 A Condensed History of U.S. Highway Development Since 1792

The first major highway “network” in the United States can be traced back to the Post Office Act of 1792 authorizing the government to construct “post roads” for the delivery of mail. Within eight years the network increased by over 250% to 21,000 miles and facilitated the westward growth of the country (U.S.P.S., 2008). Until 1916, roads and streets in the United States were considered the responsibility of the smallest

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8 For a detailed chronology and review of federal regulation, policy and planning see “Urban Transportation Planning in the United States: An Historical Overview” by Edwin Weiner (Praeger, 1999).
responsible local unit of government, mimicking the European tradition. That tradition since the time of the Roman Empire also included the significant use of prison labor to provide free labor to construct stone pathways (Armstrong, 1976). Public private partnerships were formed and privately funded and tolled roads were constructed during colonial days through the late 19th century, although most failed financially.

The National Federal-Aid Road Act (NFRA) was passed in July 1916 as the need for greater access and connectivity within the United States grew. Individual mobility beyond the rail network was being driven by increasing availability of automobiles and trucks. Between 1900 and 1916 more than 1,617,708 vehicles were in use (Automobile Facts and Figures, 1938). NFRA specified the responsibilities between the state and the federal government with guidelines for receiving federal highway construction funds, one of which was a state had to have a dedicated “highway” agency to receive those funds. These basic guidelines remain essentially the same almost 100 years later. During that time at the federal level, roads were still under the responsibility of the Agriculture department. The Federal Aid Highway Act of 1925 identified the need for a national highway system, but provided no funding. It did provide for a national system of assigning consistent “road numbers” across the nation.

The Act of 1925 was precipitated by the results from a U.S. Army exercise in 1919 to determine the readiness and ability to respond to a potential hostile action across country. Lead by Captain Dwight Eisenhower, 394 men with their vehicles and equipment took 62 days to make the cross-country trip. Poor roadways, mud, vehicle breakdowns caused by defective roadbeds, and lack of direct access, demonstrated the need for improvement and national leadership. In 1939 the Office of Public Roads (OPR)
became the responsibility of the Federal Works Administration (FWA). When now Supreme Allied Commander Eisenhower saw how the Autobahn in Germany had survived Allied WW II bombing relatively intact (it had been designed to handle the weight of massive German Tiger Tank high speed movements), there was political pressure for some form of a national highway system. Responsibility for highways was now transferred to the Department of Commerce (DOC) in 1949. In 1953, now President, Eisenhower again lobbied for an effective national defense highway system and Congress passed the Federal Aid Highway Act of 1956 creating “Interstates.”

National defense requirements primarily dictated the initial standards for the Interstate and Defense Highway System, not commercial or public needs. Efficient and fast armament and troop transport required the infrastructure to have limited access, twelve feet wide travel lanes, and physical geometries of design such as 14 feet bridge clearances (to accommodate a transporter with a tank or Howitzer type artillery on it). As the Interstate became a reality many city governments realized they were being “bypassed” and were concerned as to the negative effects of this approach on their individual economic development. These concerns lead to the creation of the Municipal Planning Organization (MPO) structure and subsequent incorporation into the 1962 Federal Highway Act, which remains substantially in force today for Federal-State Long Range Transportation Planning. In 1966, surface transportation (highways and transit) was incorporated into the new Department of Transportation (DOT) as the Federal Highway Administration (FHWA).

By 1950 the U.S. population was 150 million and the Highway system had 3.3 million miles of roads and 50 million cars travelling 500 billion miles per year.
(Cambridge Systematics, 2008). In 2007 the system was composed of over 4.0 million miles of public roads in 7 categories with 594,101 bridges serving 3.0 trillion vehicle miles of travel and more than 250 million vehicles on the road (ASSHTO, 2007). The physical highway system grew only 20% in 50 years (although the percentage of paved roads grew more rapidly). However, in 27 years the population doubled, the number of vehicles in use grew five-fold, and highway travel grew six-fold. Since WW II the physical and social environment within which federal and state long-range transportation planning had been executed dramatically changed; yet the underlying use of single point estimate rational planning models of predict-then-act, and the policy architecture based on the output of those processes did not.

The U.S. highway network was further complicated beyond its growth, usage and physical characteristics by the nature of its evolved ownership and management. On average, States own approximately 20% of the total system (Statistical Abstract of the United States, 2012-2013), counties 45%, town/municipalities 31%, federal 2% and others 3% (Cambridge Systematics, 2008). The primary public ownership matrix is composed of 1 National entity (the Federal Government, although with many subsets: Bureau of Land Management, Indian Affairs, DOE, etc), 50 states, 3,044 counties and 35,933 towns and municipalities. In addition there are 35,052 special and 13,506 school districts which also become part of the transportation planning process depending on the location and use of the intended infrastructure (Giuliano, 2007). There is also wide disparity in the ownership distribution across the states from the mean of 20%. Delaware and West Virginia are tied at 89%, owning the most surface transportation network in
their respective states, and New Jersey the least with 6% ownership (FHWA Highway Statistics, 2010).

Overlaying this highly complex network of geographically diverse and jurisdictionally disjoint transportation elements is a singular federal long-range planning process based on a rational planning model that by law must be applied uniformly to all states and is frequently referred to by transportation planners as the “one size fits all” federal approach to transportation policy. The geo-political and social boundaries within the United States have virtually no relationship to the network boundaries of the four million mile long public system. It has been argued in the literature that the isolated and linear reductionist RPM approach is incapable of handling heterogeneous and complex systems when there are indeterminate future conditions, such as in transportation, and then expect the resultant policies created to be robust, resilient, and sustainable (Black and Kuranai, 1980; Khisty, 2005; Lempert, 2007; Lewis, 1995; Mierzejewski, 1995).

2.3 Evolution of US Transportation Policy and Planning Analysis

Strategic and analytical development of highway planning in the United States began in the early twentieth century and looked at the origins and destinations of travelers and population growth. Planning essentially was limited to forecasting future demand where demand previously existed and estimating needed expanded infrastructure construction. In the mid twentieth century the concept of the gravity model was developed. The first significant application of this concept to transportation infrastructure planning was with the publication of *A General Theory of Traffic Movement* (Voorhees, 1956). This methodology is still in wide use almost sixty years after its inception. The
National Academies of Science in *Special Report 288 Metropolitan Travel Forecasting: Current Practice and Future Direction* (2007) stated “Most fundamentally, the processes that represent travel demand in the four-step model are not behavioral in nature.” The failure of the four step model specifically, and linear transportation planning generally, to incorporate more behavioral components can be found in the literature several decades prior to the 2007 National Academies of Science report (Lewis, 1993; Pell, 1984; Wingo and Perloff, 1961).

The first modern U.S. regulatory attempt at national scale urban transportation planning policy was the Federal-Aid Highway Act of 1962 (P.L. 87-866) which mandated planning for urban centers over 50,000 population. Two key elements of the 1962 Act were a continuing, cooperative and comprehensive planning procedure (3C), and the creation of administrative Metropolitan Planning Organization (MPO) architecture. The “comprehensive” component listed 10 key areas for planning consideration in an attempt to achieve a “systems” perspective and is shown in Figure 2.

The identified basic elements of the 3C planning approach were to be implemented through the MPO administrative process. As of 2010 there were 486 MPO qualified urban areas in the United States (Bureau of the Census 2010) and 342 functioning MPOs as of 2012. The passage of time has raised questions as to the validity and salience of this more than fifty year old, one-size-fits all, administrative procedure and structure to meet the needs of the existing transportation system (Rodier, 2007).
## Figure 2

### Ten Basic Elements of a 3C Planning Process

1. Economic factors affecting development
2. Population
3. Land use
4. Transportation facilities including those for mass transportation
5. Travel patterns
6. Terminal and transfer facilities
7. Traffic control features
8. Zoning ordinances, subdivision regulations, building codes, etc.
9. Financial resources
10. Social and community-value factors, such as preservation of open space, parks and recreational facilities; preservation of historical sites, buildings; environmental amenities; and aesthetics


States and MPO’s must follow these rules and plan for a variety of segmented and mixed levels of federal, state, regional and local requirements which do not necessarily have a cohesive national focus context (Giulano, 2007; Hutchison, 2009). A state can “go its own way” if it wishes and not follow federal transportation guidelines, however, it must then forgo all federal transportation funding support.9

The Interstate and Defense Highway System (Interstate) and the National Highway System (NHS) have been the only recognized national surface transportation programs during the past 50 years. There has been no replacement of this national construction policy since the Interstate network’s physical completion approximately 25 years ago.

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9 Federal funding can be withheld by the USDOT if a State does not have an approved Long Range Transportation Plan. Even with no plan for as long as 3 years after a 5 year planning cycle (8 years), no State as of August 2015 has ever had funding withheld or delayed for lack of having a current Long Range Transportation Plan.
Since 1962 federal funding for transportation infrastructure has become more comprehensive and inclusive, yet at the same time more prescriptive and restrictive (Guiliano, 2007). Steve Heminger, a member of the National Surface Transportation Policy and Revenue Study Commission, argued in his 2009 testimony to the U.S. Congressional Subcommittee on Surface Transportation that “There are 108 separate categorical surface transportation programs in current federal law. It is safe to say that any agency of government with more than 100 priorities really has none at all” (Heminger, 2009). The US Government Accounting Office in 2009 in its report to the U.S. Congress indicated that after 30 years of federal funding oversight focused on process rather than outcomes (USGAO-09-868, 2009).

The latest federal transportation funding bill: Moving Ahead for Progress in the 21st Century Act: MAP -21 enacted in July 2012, consolidated program categories from 108 down to 30. However, the implementing regulations for the 108 programs and the MPO architecture did not change, effectively still constraining flexibility. Performance measures in MAP-21 are required to be multi-modal in scope, yet consideration of air, rail, pipeline and sea transportation were excluded since their funding was not concurrent with MAP-21 and crossed federal agency jurisdictions; holistic planning without the whole. No national priority has yet been set as to what the national transportation system should achieve, only how. The legislation appears to assume that if states optimize how their individual funding is utilized, then the entire country should benefit as a whole. This approach would appear to run counter to the economic theory known as the “tragedy of the commons.” A circumstance in which multiple individuals (in this case states), acting
independently and rationally for their own benefit, will ultimately deplete a shared resource, even when it is not in anyone's long-term interest to do such (Hardin, 1968).

Modern transportation long-range planning starting in the 1950’s and defined the problem to be solved as connectivity driven by population movement. In the late 20th century it was project driven with the design, construction and implementation of the Interstate Highway System dictated primarily by logistical national defense interests. In the 1990s it was congestion mitigation driven by land use, travel demand management and air quality improvement. The current federal program structure is driven by a mono-modal approach, both in process, program and organization (Canby, 2009). The end of the Cold War in 1991 changed the 45 year-old political perspective of communist versus non-communist, to a new paradigm of “market blocks” and the US transportation system is no longer a isolated self-determinant activity. It is now part of a larger global transportation network, where it is a part, and not the whole (Gallis, 2008).

The literature has demonstrated that since the beginning of modern auto oriented transportation long-range planning in the 1950’s the definitions of the transportation problems to be solved, and the contexts of the solutions, have dramatically changed. Traditionally the pre-eminent activity of transportation planning practice was once the technical exercise of forecasting future demand and calculating capacity of new construction (Handy, 2002). The US transportation system today is no longer an isolated self-determinant activity, but rather part of a larger global transportation network that completely redefines the scale and nature of the problems to be addressed. This paradigm shift has created even greater uncertainty and risk.

Current federal
transportation policy and the RPM model ask questions dimensioned by outdated problem definitions based on connectivity, and capacity limited by national boundaries.

The classical reductionist RPM transportation planning currently used is not effective in an uncertain environment if it can only offer a best guess time-restricted solution to a policy question (Lewis, 1995). The determinism of a single-point RPM best guess thus creates apparent credence where there is none and further amplifies the future risk of policy failure (Davis, 2000). Kuruvilla and Dorstewitz argue that that there is no “point” in decision making and the holistic perspective for public policy making has been lost (Kuruvilla and Dorstewitz, 2009). The quality of long-term transportation policy development therefore suffers when the rational planning model is used outside its primary short-term deterministic scope of competency (Metlay, 2012).

Except in the most bounded short-range or deterministic of circumstances, long-range transportation planning operates under the deep uncertainty conditions as described by Lempert. Although one may desire a specific future outcome, one cannot guarantee it. The underlying requirements of the Code of Federal Regulations Title 23 Highways, Part 450 Section 206 Statewide Transportation Planning Process: General Regulations, institutionalizes by law the requirement for forecasting and planning for single point estimates. This inherent regulatory weakness thereby materially increases the potential for future transportation policy failure.

The preponderance of the practice literature on long-range transportation planning identifies the need for change, yet executes that change within the context of the same traditional reductionist RPM philosophy (Rodier, 2007). Without a valid plausible future
context, as mathematician John von Neumann (1903-1957) stated, “There is no sense being precise when you don’t even know what you are talking about.” The continued use of the reductionist RPM philosophy and associated regulatory structure cannot provide the necessary guidance for effective future long-range transportation policy decisions needed for a complex system that exists in a constantly evolving stochastic environment.

2.4 Planning Methods Evolution into Practice

W. Edwards Deming observed that “A System cannot understand itself. The transformation requires a view from outside.”¹⁰ Historically, even when transportation as a profession has looked outside for best practices; “outside” was limited to other geopolitical boundaries of city, county, state, or country transportation agencies and departments both domestic and foreign. From a Deming philosophical perspective this outside would still be considered inside.

Figure 3 depicts the rate that seven major classes of modern Multiple-Criteria and Multiple-Attribute decision and prioritization methodologies have progressed over time into planning practice in diverse disciplines. The degree of discipline penetration is measured by the number of peer reviewed research articles represented in 8,650 journals from the Institute of Scientific Information (ISI) database that employ these techniques to value and prioritization options in policy decision making (Wallenius, et. al. 2008).

¹⁰ W. Edwards Deming (1900-1993) is considered the father of Total Quality Management (TQM) and focused on creating manager skills that avoided the reductionist perspective. He is credited with leading the renaissance of Japan’s industrial recovery after WWII by using this principle. (https://deming.org/theman/overview, accessed 08-11-2015).
The seven classes are composed of the following methodological categories:


2. **Goal Programming**: an extension of linear programming which minimizes variation from a desired set of *a priori* goals or achievement targets.

3. **EMO**: Evolutionary Multi-objective Optimization uses concepts from human genetics to create non-dominated solutions (survival of the fittest) with preference not initially considered.

4. **MAUT**: Multi-Attribute Utility Theory uses a rank ordering scale of 0= worst and 1= best for scaling preferences in evaluating options.

5. **Mathematical programming**: Operations Research (OR) approaches not otherwise classified in the bibliographic analysis.

6. **French School**: a method of creating a weighted sum of options and elimination criteria to reduce size of the potential solution space.

7. **Vector Optimization**: simultaneous linear optimization of multiple objectives subject to constraints and a given order.

AHP, the Analytical Hierarchy Process over a 20 year period grew faster in application and had a greater number of citations than any other methodological class. Of the 9,766 articles classified, 72% of the published research was for applications in business, manufacturing, computer science, and economics related disciplines. Less than 3% were in civil engineering related areas. There were insufficient explicit transportation examples in the database to warrant a separate classification.

It can be inferred therefore that AHP and the other identified advanced planning methodologies have been slow to be accepted within long range transportation planning practice relative to the other identified venues.
The AHP methodology is recognized as being able to structure highly complex systems and generate quantified and prioritized options that meet the goals of participant’s intensity of preference (value) for selected criteria with, or without, financial constraints considered. More importantly the AHP methodology overcomes constraints imposed by Arrow’s Impossibility Theorem and can create a social welfare function that essentially satisfies all four of Arrow’s conditions by employing cardinal versus ordinal measures (Saaty and Peniwati, 2008). A practical application of AHP for transportation planning prioritization is described in the DelDOT case study Chapter 4, with the analytic architecture of AHP described in Appendix D.

2.5 Literature Synthesis and Conclusions

Federal-state long range transportation planning has continued to develop best guess single point estimates to inform future policy decisions based on the linear extrapolation of historical trends driven by the regulatory requirement for a “single buildable plan.” This has been shown to be unreliable (Lewis, 1995; Khisty, 2005). These single point estimates yield apparent cognitive determinism where there is none (Davis, 2000). The cumulative effect of this has contributed to the bounded rationality of the current federal-state long range transportation planning process. Long term transportation infrastructure policy planning at the federal-state level appears not to have taken full advantage of advances made in the last 40 years in multi-criteria and multi-

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11 The social welfare function as used here is the mapping of individual preferences or judgments as to collective choices for transportation infrastructure, which will ultimately apply to all people, regardless of an individual’s preference, and develop a ranked order of options that can be described as the best desired robust outcome based on intensity of preferences, although not necessarily optimal.
attribute decision making methodologies that can better inform robust policy
development.

Current transportation problems have been defined or “framed” and funded within
the organizational construct of the U.S. Department of Transportation by project category
as mandated by successive funding bills into managerial silos as air, highway, transit,
rail, and bicycle, etc. The preponderance of literature argues that the U.S. DOT and
Federal Highway Administration “silo” organizational structure is ineffective and
outdated and does not reflect the nature of current and future transportation infrastructure
problems (Canby, 2009; Giuliano, 2007; Heminger, 2009; USGAO, 2009). Policy
challenges transcend the project specific “silo” and programmatic orientation of the
FHWA and require a more comprehensive perspective (Giuliano 2007).

As stated by Krippendorff:

“Problem Formulation is an activity aimed at identifying a problem by
specifying (a) the undesirable and problematic state currently occupied,
(b) the resources currently available to move away from that problematic
state, particularly the available courses of actions, the combinatorial
constraints on using them, etc., and (c) the criteria that need to be satisfied
to say that a problem no longer exists or is solved. This activity defines the
cognitive gap between what is and what is desirable and delineates the
resources for closing it. Problem formulation is the creative and probably
the more important step towards overcoming a problematic state than
problem-solving. A good definition of what the problem is believed to be
more than half of the way towards its eventual elimination” (Krippendorff,
1986).

Transportation infrastructure problem definitions have changed since WWII and
continue to evolve. However, the USDOT-FHWA organizational infrastructure to
address them has not materially changed. It is axiomatic that if strategic policy is
determined within a faulty organizational construct with a defective problem definition
perspective, the developed tactical solutions will be sub-optimal, regardless of the
performance or success criteria utilized, except by random chance. The literature indicates that there is agreement from all sectors that there are insufficient funds to support and maintain the United States transportation infrastructure that was created as a result of that planning. There is ongoing disagreement, however, as to which component of transportation infrastructure is more important than the other, or first among equals, and deserving of greater emphasis, focus, and funding. This ongoing disagreement may indicate the need for better decision tools or improved collaboration that can lead to greater clarity and insight in defining values and desired future outcomes.

The literature supports the notion that long-range planning and transportation infrastructure policy robustness could be enhanced if better analytic and behavioral/social decision sciences methodologies were employed even within the context of existing administrative divisions and constraints. These improved approaches consider cognitive issues in their constructs. When performed in an organizational environment that fosters innovation that better reflects the stochastic nature and uncertainty of future problems to be solved, the potential for insight is enhanced. Urban Planning policy development appears to have evolved in this direction in advance of transportation, even though transportation is an aspect of the same physical space (Hudson, 1979). Urban planning however operates generally in a more “home rule” environment, versus transportation planning which is executed in a more rigid federal-state administrative hierarchy.

The convergence of inherent human cognitive limitations coupled with confining prescriptive transportation planning processes and organizational structures appears to have limited transportation planning progress, and exacerbated the ability to generate insight in long-range transportation planning for robust and resilient policy development.
The information learned from the literature search formed the starting point of investigation that helped inform my original research to better identify the reasons for the current condition of federal-state long range transportation planning, challenges to its modification, and the identification of potential better tools for policy development. The balance of this document is focused on the research that was undertaken, the findings developed from that research, and the recommendations resulting from that effort.
CHAPTER 3 - RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the strategy and methods utilized in the dissertation research. The literature review showed that several disciplines at the practice level for long range planning have at least partially replaced reductionist, single point estimate rational planning approaches with alternative multi-attribute and multi-criteria decision tools to help better inform policy development. The newer methods while rarely used have demonstrated varying degrees of success, yet appear to have generally helped better inform and develop policy selection rather than relying only on the single point linear RPM predict-then-act approach; even though there has been, and continues to be, strategic level policy turmoil in many disciplines. Does long range transportation planning therefore “fit the same mold” as these other disciplines? The majority of the published transportation-specific practice literature appeared to be constrained and conceptually limited by the very same “silos” and rational planning techniques and assumptions it sought to understand and explain.

A three-part research design was developed. The research design is composed of a case study for a specific state DOT (Delaware), an analysis of published State long range past and present transportation plans for the fifty states, and phone interviews of State Department of Transportation (DOT) Planning Directors responsible for their state’s long range transportation planning processes and plans. The three research components are described individually.
3.2 The Case Study

In the case study of the Delaware State Department of Transportation (DelDOT), I utilized a combination of action research and an ethnographic approach. Action research is a form of inquiry where the practitioner evaluates his or her own practice within the professional culture in a systematic way with a continuous cycle of observe-reflect-act-evaluate-modify-repeat, with the objective to create beneficial new knowledge (McNiff and Whitehead, 2011). The ethnographic element involved analyzing the group culture and practices at DelDOT.

The Analytical Hierarchy Process (AHP) methodology is compared to the previous prioritization approach used by DelDOT, and the case examines the change and the potential impact on the quality of long range transportation planning decision making and policy outcomes. The political and administrative environment which led to the decision by the agency to change its planning prioritization process is described. The literature research indicated, and the State Planner Director Interviews confirmed, although AHP is a widely utilized and successful prioritization methodology for valuing and linking qualitative stakeholder values with quantitative data for informing policy decisions, its use was virtually nonexistent in state long range transportation planning through 2013.

As of 2015, approximately six States have either initially implemented AHP or are now evaluating its use, although none of the applications are for long range transportation planning analyses. For five of these states, the move to test AHP came about as a result of the dialogues between the author and the State Planning Directors.
during the research interviews, and subsequent requested follow-up on the AHP methodology.

3.3 State Level Long Range Transportation Plans

State long range transportation plans (SLRTP) are required by federal regulation in order for a State to receive federal funds and must have a minimum twenty year planning horizon and be updated every five years. This component of the research focused on how the plans have evolved since becoming a federal requirement in 1991. All State transportation long range plans are available for review on the internet via the particular state’s DOT website (although in many cases not easily found).

The research involved reading, reviewing and categorizing the plans as to planning philosophy (needs, vision, policy, project or corridor), plan page length, and identifying the methods employed to consider future conditions for policy development. In addition, goal mapping analysis (GMA) is used to identify the degree of alignment between state mission statements and prioritization of programs; that is looking to see if what is said, is what is done. These same areas of interest were explored with the State planners in the phone survey.

The analysis of the state plans sought to answer the following four questions:

1) What long range planning methodologies are being employed?

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12 Goal Mapping Analysis (GMA) is a business process reengineering (BPR) technique to match or develop goals based on developed values or desires. Consistency can be checked by matching the ranked priority of each against each other. Lack of consistency may indicate poor strategic problem formulation, confusion in objectives, or poorly defined goals and objectives leading to a lower probability of achieving the defined/desired measure of success.
2) Has there been methodological innovation over time, and are those advancements being utilized in the policy development process for the long range plans?

3) How are policy variables prioritized in decision-making and what methods are used to determine the variables of interest?

4) What time horizons are utilized in the planning process, and how does this affect the transportation policy decisions developed?

As the review of the long range plans progressed, the information found in the plans proved to be of less value in helping answer the thesis questions than was anticipated. However, in several cases, the absence of the desired information in the plans proved to be informative in their own right, when coupled with the responses acquired later from the interviews with the State Directors responsible for the specific state long range transportation plans. Notwithstanding the quality of the plans I thought it was important to be fully informed about a State’s long range transportation plan prior to initiating a phone interview with a State’s Director of Transportation Planning.13

3.4 Phone Interviews of State Directors of Transportation Planning

A review of the literature did not find any significant research on the philosophical, cognitive, and intellectual perspectives of transportation planners at the state level, and why and how methodologies were selected or rejected in their relation to

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13 All Directors contacted were uniformly both surprised and appreciative when I informed them that I had read their state long range transportation plan prior to initiating the interview.
policy in developing state-level long-range transportation plans.\textsuperscript{14} The research interviews were intended to find out what was really happening from people “on the ground” who actually managed and executed the long range transportation planning process and their perspectives on the culture, political agendas, power centers and assumptions that inhibit, constrain or advance change in long range transportation planning. Of particular interest was what they thought might improve long range planning processes to yield better policy outcomes. One goal of this survey was to try to understand how demographic and cognitive considerations color the planners’ perceptions and framing of what are the “best” policy options for their state long range planning. The survey component of the dissertation research was intended to help fill this knowledge gap and better understand where the emphasis for change should be, what to change, and identify the degree of improvement these changes might bring in the quality of long-range planning, thereby increasing the potential resilience and robustness of future developed transportation policy.

A structured phone survey of every state level planning director was designed. The survey instrument (Appendix A) was composed of 22 open-ended questions divided into four categories of interest: process and organizational considerations (6 questions), planning perceptions (6 questions), methodology considerations (5 questions), and demographic/background data of the respondent (5 questions).

This survey appears to be the first to ask questions of state planners about their personal perspectives of the entire process of planning and its operating assumptions, not

\textsuperscript{14} Surveys of state DOT and MPO personnel were found that covered operational issues on performance measures, funding, congestion management, air quality, and system operations, etc. All these surveys assumed \textit{a priori} functional planning processes and did not question the process architecture itself, only the program factors within the processes. The Handy study of 2002 did inquire as to certain educational perspectives (Handy, et. al, 2002).
just hit or miss specifics on a particular regulation, program or practice. A limitation of
the survey is that the 50 state Directors of Planning, are players representing a part of a
much larger long range transportation planning process in the United States. However,
these planning managers have the potential to wield significant influence as to who
develops the plans, how long range plan research is conducted, what planning methods
are used within their respective states, and can make recommendations on future USDOT
and FHWA planning policy directions at a national scale.

The survey was designed to elicit information on four topical areas: 1) planning
processes and how organizational constructs effect performance, 2) planner perceptions
on planning activities as to quality, support and success, 3) factors influencing
methodological selection and subsequent outcomes, and 4) demographic and
background information about the respondents. The questions are based on the
experience of the researcher in the planning field informed by the thesis literature review
and guidance from the researcher’s doctoral committee.

The survey participants, all chief planning managers or directors, were identified
by reviewing all fifty state DOT websites and cross checking names and positions with
the current membership of the American Association of State Highway and
Transportation Officials (AASHTO) Standing Committee on Planning (SCOP); whose
members are usually at the highest levels of transportation planning within each state and
responsible for long-range planning. Formal written approval for the phone survey was
received prior to any solicitation from the AASHTO staff manager responsible for SCOP,
the Director of Planning for the Delaware Department of Transportation (author’s
employer at the beginning of the research) and the approval of the interview protocol itself by the Rutgers University Institutional Review Board.

A matrix of all state planning managers/directors with their organizational and contact information was created. It was established early in the research process by informal discussions with several state planning directors, and assistant directors at professional forums that voice recording of the interviews would be frowned upon and not advisable. These directors also recommended using email as the primary method of contact, as telephone calls from research firms or individuals were not high on their priority to respond (all calls were filtered by administrative or secretarial staff). It was still difficult to elicit responses even with email and phone follow-up. Early interviews proved this to be the case, and all interview question responses and notes were manually hand written as an interview progressed. At the end of each interview, the notes I had written were immediately reviewed again to clarify any abbreviations or short hand notes and symbols I made that might later be forgotten.

All survey candidates were initially contacted by email with the header of the email reading:

RE: Phone Interview on Long-Range Transportation Planning, Processes, Perceptions, Methodology, Demographics

The body of the email contained the following text:

As part of a research project at DelDOT and completing my doctoral dissertation requirements I am conducting a phone survey on how organizational structures and methodology approaches mold our long-range transportation plans. If you do not handle the long-range plan process for (State name) I would greatly appreciate a point of contact. The interview is expected to be about 30 minutes. I have attached a copy of the interview questions for reference; however the intent is for an open dialog conversation. I will make myself available at any time and date that is
convenient for you to conduct the phone interview. I greatly appreciate your time and consideration of this request; when I started the research I did not realize how many requests like this SCOP members receive in a week! Thanks and regards, Mike

If no response was received from the initial solicitation, follow up was attempted up to five times by email with at least one phone contact. The interval between follow-up attempts ranged from one week to one month. If a positive response was received, a time was set up for the telephone interview and a formal copy of the interview question set (Appendix A), Introduction and Recruitment letter (Appendix B), and the IRB Informed Consent Information (Appendix C), were emailed to the respondent for review.

It was discovered rather quickly that state level planners are in fact besieged with similar requests via phone and email for survey information of various types. From the very first interview the issue of “available time” came out from all respondents. It became even more apparent as the author was appointed an Acting Director of Planning for the Delaware Department of Transportation (DelDOT) in February 2011. In this new capacity direct email requests to me for information hit a peak of 600 per day and averaged over 215 per day for eighteen months. The requests came from USDOT and FHWA personnel and contractors, Delaware State Legislators, DelDOT personnel and contractors, independent researchers, and the general public. Appointment to this new position interrupted the ability to conduct further research interviews.

\[15\] All unattributed comments, and partial and full quotes referenced in Chapters 4, 5, 6 and 7 are anonymous per the Rutgers IRB protocol requirements. All attributed quotes referenced in the research received permission from the quoted individuals for their use in this document.
Sixteen phone interviews were completed from March 2010 through late spring 2011 at a rate of approximately one interview per month. An additional five state Planning Directors informally answered some of the research questions when the opportunity arose to discuss them during other unrelated contact within the survey period. Although not incorporated into all of the overall dataset of responses, there was complete convergence in those responses for applicable questions to the formal survey responses.

The Rutgers University Institutional Review Board (IRB) approval for the interview protocol (10-088M) required that linkages between participants and the data collected be confidential except to the research team and the IRB. Public access is therefore limited to group results only.

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16 The survey process ceased for 16 months until September 2012 when I was no longer the Acting Director of Planning and could resume the survey protocol. Subsequently additional delays were caused by sequential exogenous events of Super Storm Sandy, resulting in evacuation and damage to the author’s home, loss of employment and then endogenous serious personal and family illness. Ultimately upon resuming the interview protocol 26 State Planning Director’s participated in the formal interview process plus 5 additional informal partial interviews (31 total). The last interview was conducted on January 3, 2014.
“I don’t have time for planning. I have real problems to solve.”
Elected Delaware Official 2009

-CHAPTER 4-

DELAWARE DEPARTMENT OF TRANSPORTATION CASE STUDY

4.1 Introduction

The Delaware Department of Transportation (DelDOT) Case Study is composed of seven sections. Section 4.2 describes the reasons for the case study. Section 4.3 provides a background and transportation history of Delaware. Section 4.4 describes the DelDOT organization and its historical planning practices. Section 4.5 focuses specifically on the planning environment during the 2009-2014 period. Section 4.6 compares old planning prioritization processes at DelDOT to the new Analytical Hierarchy Process (AHP) based approach that was tested. AHP was selected as DelDOT’s core analytical prioritization methodology in 2013 (see Appendix D for a description of the AHP mathematical architecture). Section 4.7 synthesizes the information with conclusions and recommendations.

The case study fact gathering began in the Fall of 2009 while I was employed by the Delaware Department of Transportation and continued until May of 2012. The case study process stopped due to my departure from DelDOT in May of 2012. Analysis of the case study data resumed in the Fall of 2013 and continued until completion. Additional public data needed to complete the case study that was not available from the
DelDOT website was provided by staff members of the DelDOT Planning Department in 2014 and 2015 via email requests and interviews.

4.2 Context

The author joined the DelDOT Planning Department in October of 2007. During the first 12 months, I was assigned to represent the Director and Secretary at various regional and national transportation events on transportation planning and performance management, including the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on Performance Management (SCOPM). I was to report back on potential future implications for transportation planning in Delaware. Responsibilities also included the analytical evaluation of transportation proposals and issues raised by elected Delaware State Senators and Representatives on their behalf and that of their constituents that required a level of analytical analysis not familiar to existing DelDOT staff.

One such example brought to the Secretary was a challenge to a complex multi-intersection improvement program where a Senator invoked Braess’ Paradox as a reason not to do the project.\textsuperscript{17} The Secretary asked that I evaluate the challenge. A rigorous analysis demonstrated that Braess’ Paradox did not exist in this specific project even under the most extreme of operating assumptions and scenarios. Upon further discussions with management and operating personnel within the agency, it was discovered that the level of understanding of this concern, as well as other well established methodologies in econometrics, operations research, and multi-criteria and

\textsuperscript{17} Braess’ Paradox occurs in a user-optimized network where adding extra capacity actually reduces overall network efficiency rather than improves it.
multi-attribute decision making was quite low within the department. Knowledge of quantitative and qualitative social and behavioral science methodologies was negligible. The depth and breadth of knowledge in civil and mechanical engineering methodologies was, however, quite superior.18

As my involvement in the planning department increased, I observed that planning methodologies, particularly long range planning approaches, also lagged far behind what I had experienced in the private sector. The planning process in the DelDOT 20 Year State Long Range Transportation Plan (SLRTP) was rigidly adhered to and was based upon a reductionist single point linear forecast estimate of population growth by county. The projected induced traffic volumes were then used to determine future infrastructure project plans.19 The approach to acquire public input and their value preferences for prioritization was weak; generally incorporating only a predetermined DelDOT array of options by mode for review at public meetings, in other words, after the planning process was well underway.

Personal experience and the planning literature had identified the weakness of linear reductionist single point estimates as a basis for prioritizing and valuing long-term policy recommendations because the real world environment is marked by deep uncertainty and risk. Risk and uncertainty was absent in The Delaware SLRTP, except for lack of funding being the significant risk.

In discussion with the planner responsible for the Long Range Plan, she stated “That’s the way we have always done it. It doesn’t really matter, nobody reads it anyway.

18 Hard engineering sciences such as soil mechanics, hydrology, strength of materials, geotechnical, structural and construction methodologies, and analytical physical traffic management methods were strong.
19 In Delaware all state agencies in order to assure consistency are required by law to only use population forecasts, without modification, as developed by the Delaware Population Consortium.
If it wasn’t for the Feds we probably wouldn’t do it at all, and then we would save money.” The response was surprising considering the state was spending more than $250 million per year in capital transportation infrastructure projects. Apparently long range planning was not considered a valuable process. Was the utilization of an ineffective methodology and the negative attitude expressed about long range transportation planning unique to the Delaware DOT, or was this perspective common among other State DOT planning departments?

4.3 State Background and Transportation History

The State of Delaware is located on the Delmarva Peninsula, three quarters of the state and the balance of the peninsula are an island created by the C & D Canal in the north, the Chesapeake Bay on the west, the Delaware River and Atlantic Ocean on the east, and the southern end of the peninsula ending at the Atlantic Ocean and the mouth of the Chesapeake bay as shown in Figure 4. In the United States, Delaware ranks 45th in population (913,000), 49th in total area (2,489 sq. mi.), and 8th in population Density (461 persons/sq. mi.). The State is 96 miles long and varies in width from 9 to 35 miles and has a total of 13,507 lane miles of public highways. It has the largest out-of-state worker commutes of any state in the nation at 14.8% (Maryland, Pennsylvania, New Jersey, Virginia, Washington, D.C, and New York City) and the least Interstate mileage at 41 (U.S. Bureau of the Census, 2010).

The Delaware Highway Department was established by the Delaware General Assembly in 1917. The action was motivated by passage of the Federal Highway Act of 1916 which required a state to have a highway department to receive federal aid.
Figure 4

Delmarva Peninsula Map

A prominent family in Delaware history, the du Ponts, were responsible for the first modern high speed highway in the state. Started in 1911, T. Coleman du Pont purchased the real estate and helped design and build Route 13 with his own finances. Route 13 (du Pont Highway) runs the entire length of the state with a 200 foot Right-of-Way. Route 13, also designated as Route 1, can be seen in Figure 5. Coleman du Pont donated this entire highway system to the State of Delaware in 1924. (Transportation in Delaware, 2005).

In 1976, the Highway Department was renamed the Delaware Department of Transportation (DelDOT). Except for the name change, there were no organizational or functional changes in operation. Until 2008, DelDOT would still be referred to by successive Governor’s as the “Highway Department” and a standing joke within the agency. The agency is designated as an Authority within the state and responsible for all transportation modalities and access control. This translates into approximately 89% of the entire physical public transportation network and 100% of permit control of private access to the public network (Delaware Transportation Facts, 2012). Delaware and West Virginia are the only two states with such significant control and ownership of their physical surface transportation network; although West Virginia has only access authority over Interstate and major arterials.

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20 Although called the “Department of Transportation,” three Delaware Governors and most Delaware legislators still called it the “Highway Department” in meetings and legislative directives. The DelDOT staff felt they were “transportation” in name only and the policy focus and management perspective was primarily only on highways.

21 State ownership percentage was one of the “scale” variables identified in later interviews with Planning Directors as an example where a “one size fits all” Federal regulatory approach in their opinion distorts planning perspectives and results in sub-optimal allocation of limited funds by not directly considering the degree or scale of a state’s network ownership.
-Figure 5-

Map Showing Delaware Route 13

4.4 DelDOT Organization and Historical Planning Practices

The Delaware Department of Transportation is composed of eight primary divisions under the Secretary of Transportation who reports directly to the Governor. The eight divisions are:

1. Transit (which has its own separate distinct planning arm for the state)
2. Finance
3. Human Resources
4. Maintenance and Operations
5. Motor Vehicle (inspections and licensing)
6. Planning
7. Technical Support (internal computer systems and telecommunications)
8. Transportation Solutions (although titled “transportation,” authority is limited to highways and bridges)

The DelDOT organizational construct is typical of state DOTs except for a real estate acquisition group within the planning group. The scale, number of subset divisions, and staff size, varies depending on the size and diversity of the state’s transportation network, physical geography, and degree of direct regulatory authority.

\[22\] In 2013 the real estate acquisition group was removed from the planning division and placed in the DelDOT transportation solutions division (engineering and construction). This new administrative alignment matches other state DOTS.
The Mission Statement of the DelDOT Planning division is:

“The mission of the Planning Division is to provide excellence in transportation through an inclusive and comprehensive transportation planning and permitting process that seeks solutions to the state's transportation needs by balancing safety, choice, environmental stewardship, economic development, financial accountability, and quality of life.”

(Source: [http://www.deldot.gov/home/divisions/](http://www.deldot.gov/home/divisions/))

In 2012 the DelDOT planning division was composed of 92 employees. However, only 8 professionals were actually involved in planning processes of any type; 37 were in real estate acquisition and management, 22 in permitting and regulation, 8 in data management, 3 in construction, 3 in map maintenance, and 11 clerks and secretaries. It would later be discovered during the State Planning Director interviews that this was a highly unusual organizational structure for a state DOT planning division. Real estate acquisition and access regulation did not exist in any of the other planning departments for the 26 states where Directors were interviewed. These two functions represented 65% of the DelDOT planning division headcount with these formal job descriptions identified as purchasing and regulation positions.

The Delaware DOT organizational structure was unusual in that it had personnel charged with being regulators, advocates, and stewards all at the same time; thus creating conflicts in strategic direction and mission.23 The staff frequently complained that it was

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23 For example, a conflict arose where a developer wished to develop property in a rural area for mixed commercial and residential use. The planner analyzed the plans to determine if the project met the technical requirements for access (it did not), level-of-service after completion (it did not), and calculated network upgrade (mitigation) costs that the developer would have to contribute. The new use would be in conflict with the State approved Comprehensive Development Plan (CDP) that called for the area to remain agricultural in nature. The Office of Economic Development challenged the DelDOT decision as it would “cost jobs. The planner and Director were overruled on all three issues and the development approved without developer financial contribution.
not clear as to who they were supposed to represent in their decision making and which “hat” they wore appeared to be a function of the extent of political involvement with a project or program. This situation did not exist in the 26 States where Planning Directors were interviewed; advocacy for integrated planning and stewardship, and not regulation, were the primary focus of the planning departments. However the priority of the stewardship versus advocacy was an issue. 24

Although the Delaware Planning Division mission statement (noted previously) indicated the division does “comprehensive transportation planning,” transit and rail are planned independently by a separate Transit Division. It is an unconnected legal entity located 55 miles away from the DelDOT Planning Department. The detrimental effects of modal management “silos” are well documented in the transportation literature (Canby, 2009; Gradel, 2013). The administrative silos still exist in the Delaware Department of Transportation as of 2015.

In 2000, Nathan Hayward was appointed Secretary of Transportation by Governor Ruth Ann Minner. He resigned in 2005 and was replaced by Carol Ann Wicks in 2006. Hayward was an administrator and financial advisor in previous Delaware administrations and a member of the du Pont family. Wicks was an employee at DelDOT for 20 years and a professional Civil Engineer. Wicks joined DelDOT directly from college graduation. In March of 2011, during Governor Jack Markell’s administration, Wicks resigned and was replaced by Cleon Cauley, then Deputy Secretary, a land use

24 The issue of stewardship versus advocacy for both projects and planning processes was a recurrent theme in the interviews conducted with the State Planning Directors. In particular, short term jobs and economic development as a trumping political factor over better long term sustainable options that may have lacked a short term impact factor. One interviewed Planning Director described this type of action as “kicking the can down the road, again.”
attorney and former staff advisor to Governor Markell. In August of 2011, Cauley was replaced by Shailen Bhatt, a former Associate Administrator at FHWA, and continued to serve until January 2015. Bhatt was replaced by Jennifer Cohan in February 2015. Cohan was the former Director of the DelDOT DMV division and a lifelong State of Delaware employee.

The period from 2004 until 2012 was a time of political and financial turmoil for the Delaware Department of Transportation. It was revealed in 2005 that significant expenditures had been made under the direction of the then Secretary of Transportation Hayward for land acquisition from 2000 to 2005 outside of the documented and FHWA approved DelDOT planning and prioritization process, although these were authorized and legal under existing general Delaware regulatory authority for a Secretary of Transportation. This specific authority was later repealed by the Delaware General Assembly in 2006. Multiple purchases of golf courses, parks, recreational areas, commercial properties, and rezoning swaps of various land parcels throughout the state took place during the period 2000-2005 outside of approved state and federal planning processes. The justification for the land being acquired by the Secretary was that it now could never be developed and would thereby reduce the need for additional funds for transportation infrastructure. However, there were multiple land transfers and zoning swaps which facilitated commercial and residential development that was counter to the stated justification. The approach used by the Secretary was not part of any existing or approved State Long Range Transportation Plan. The collective acquisitions resulted in a bankrupting of the Delaware State transportation trust fund and did not leave sufficient matching funds available for transportation infrastructure that otherwise qualified for
federal funding support with a 20% state match. A U.S. Department of Justice investigation is still in process as of 2015 with regard to actions taken during that period and certain subsequent follow-on decisions.

The lack of funds for transportation infrastructure maintenance and construction resulted in the following language being incorporated into the prioritizing and planning section of the Delaware Capital Transportation Program (CTP) Plan beginning in 2006:

“This system has been used annually until Fiscal Year 2006, when an unanticipated fiscal shortage caused the Department to retreat from its original plan and instead adopt a CTP/STIP that significantly curtailed authorization in order to keep pace with rapidly rising project costs, so as to maintain fiscal constraint. For fiscal years 2007-2009, the value of the state prioritization system was again eclipsed by the extreme shortage of funds. Instead of the normal process, the COT approved the Department’s recommendation to focus on the worst problems, because they, by their financial burden and by reasons of the magnitude of the problems they address, far out distance any of the other projects with which they might otherwise be competing. These two projects are the Indian River Inlet Bridge and the addition of the fifth lane in each direction along interstate 95 and in the vicinity of the Churchman’s Marsh. DelDOT has continued to use its prioritization processes to select and program maintenance projects, such as bridge rehabilitation and repaving projects, and continues to acknowledge the value of the prioritization processes maintained and applied by the MPOs. Should additional monies become available, DelDOT will return to using its adopted prioritization to select projects from the large and growing number clambering for attention.”

(http://www.deldot.gov/information/pubs_forms/CTP/archived/ctp06-11/proposed/index.shtml)

The Prioritization “system” referred to in the above text was developed in 1996 by the then Assistant Director of Planning at DelDOT (who later became Director and to whom I reported from 2007-2010). The process was composed of several elements and developed by him in cooperation with WILMAPCO, the largest Delaware MPO (http://www.wilmapco.org/Priority/priority.pdf). The underlined sentence referenced in the extracted CTP quote above, except for changing the relevant fiscal year timeframes,
has been used continuously since 2006 in each Capital Transportation Plan and not changed in content. The referenced prioritization process has continued to be used by the WILMAPCO MPO, although they are, as of 2014, starting to test AHP. No prioritization process was utilized by DelDOT during the 2006 to 2013 period. Instead the projects from the original CTP for 2006 were attempted in approximately the original order they were listed in 2006 as funds became available. As of 2012, approximately 75% of the projects had yet to be started.

The Secretary of Transportation and the Director of Planning were interviewed together on July 14, 2009 as part of the initial thesis research. The primary question posed was if the prioritization process was “eclipsed” (see underlined sentence in CTP quote) due to fiscal stress and its use discontinued; did not the “stressful” situation demonstrate that the process was ineffective to begin with? The collective response was yes. The Director of Planning indicated that the specific text used in the Capital Improvement Program Plan had been constructed so as to continue to qualify for federal funding and also soothe public outrage over the allegations of wrongdoing that continued to appear in the newspapers. It was stated in the interview that the original 1996 prioritization process was developed in response to the Delaware Legislature’s enactment of Title 29 Chapter 84 Subsection 8419 Transportation Priority Planning. The Act required:

“(1) establishment of a method of determining current need and costs of the entire multi-modal transportation requirements in the State which will be utilized in allocating capital funds by the transportation capital improvement program. The needs and costs will be updated annually. (2) Establish a formula-based process which shall be used for setting priorities for all Department transportation projects.”
No analysis had been done by DelDOT staff at the time to determine if the combination of the selected ordinal and cardinal measures, and their weighting factors developed for the 1996 process actually had any correlation with agency and public priorities, or any direct or indirect causality for the desired outcomes.

Previous to the interview, I had related to the Director of Planning that I had done an analysis of the prioritization process and concluded that it was “mathematically corrupt” and invalid. With a hearty laugh he said that I was correct, but I was the first person ever to notice it! The Director of Planning stated that “although the process was questionable, everyone accepted it.”

DelDOT had utilized prioritization software from AASTHO for bridges (now called BrM and previously known as PONTIS), and a contractor developed pavement management system during the time period in question that has continued in use until the present time for existing physical infrastructure. However, the resultant priorities are of an engineering nature (structural life, time to failure, etc.) and limited to only bridge and pavements for optimal economic asset life cycle management and were not applicable for, or used for, prioritization of the public’s value considerations for future transportation infrastructure and/or modes.

25 The use of planning and prioritization systems by State Transportation Agencies and MPOs that have no basis of validity is not uncommon. In a survey of MPOs 63% were found to have weak or no analyses to justify their prioritization measures (Hall, 2006). In a sample of 40 states, political support and public opinion were shown to be the predominant factor (87%) that determined the fate of transportation infrastructure projects irrespective of any documented and approved prioritization process, planning factor ratings, or their validity or lack thereof (USGAO-2005).
The planning and prioritization process used by the Delaware Department of Transportation had no validated basis upon which future infrastructure policy decisions were being made, except for accumulating projects up to a maximum available dollar amount per year. From 1996 to 2006 there was a consistent formal prioritization process in place, although it had no proven validity.

From 2006 to 2013 the prioritization process was suspended. There were in theory, still three levels of documented planning factors that all ongoing policy decisions were to consider in making transportation infrastructure decisions:26

1) SAFETEA-LU (U.S. Public Law 109-59 enacted 8-10-2005):
   a. Support economic activity
   b. Increase safety and security
   c. Increase accessibility and mobility (people and freight)
   d. Protect and enhance the environment
   e. Enhance integration and connectivity
   f. Promote efficient system management and operation
   g. Emphasize and preserve existing system

2) DelDOT Long Range Plan:
   a. Direct plans to support livable Delaware
   b. Maximize transportation choices
   c. Use cost-effectiveness as a fundamental principle
   d. Emphasize quality of life
   e. Support economic development
   f. Maintain planning and coordination as an integral activity

3) DelDOT Mission Statement: The Mission of the State of Delaware Department of Transportation is to provide a safe, efficient, and environmentally sensitive transportation network that offers a variety of convenient and cost-effective choices for the movement of people and goods.

The Secretary of Transportation, Director of Planning and Senior Planner (responsible for the direct management of the Long Range Plan development) all commented that in their opinion everybody concerned did their best to make the right decisions; although it was

26 Projects were “worked down” from the list that existed in 2006 as funds became available on a going forward basis. Very little “new information” as circumstances changed in the state was incorporated into the project plans as time moved beyond the 2006 base timeframe.
based mostly on personal experience and expert engineering judgment. Another DelDOT official later described the process as BOGGSAAT: *Bunch of guys, gals sitting around a table* making decisions. Although the BOGGSAAT approach used might be considered a form of the Delphi method, no records or performance measures were ever documented or established as to the basis for individual decisions that collectively became the overall plan for each year beginning in 2006.\(^{27}\) This ad hoc approach was employed during the eight year period from 2006 to 2013 and did not allow the opportunity for evolutionary learning within the organization. It was not possible retrospectively to determine if the lack of evolutionary learning was due to the process or the participants.

### 4.5 DelDOT Planning and Policy Environment 2009-2014

The DelDOT Agency Mission Statement until 2013 was similar in semantic structure to the stated goals and objectives identified in the existing federal funding act SAFETEA-LU (The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users 1991). This is the case in most other states (see Chapter 5). The DelDOT Director of Planning indicated that the Mission Statement was crafted with that specific purpose in mind to match the federal semantic structure yet still reflect some of the uniqueness of Delaware. He stated that it was left quite broad in structure in order to get all DelDOT Directors to agree to the wording and approve it prior to submittal to the Secretary and Governor for their final approval. The words safe, efficient, environmentally sensitive, variety, convenient, cost-effective, people and goods movement, are identified as the mission characteristics of DelDOT. However, how this

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\(^{27}\) The Delphi Method developed at RAND Corporation is a decision making/forecasting process based on a systematic, recursive, structured communications process among a panel of experts to yield consensus under conditions of uncertainty (Helmer, 1967).
translates into a cohesive strategic statement of mission is not completely clear. The mission statement can be shown to be highly ambiguous (see Figure 6). Figure 7 lists in order of priority the DelDOT goals as set by the Agency in support of the mission statement and are linked with the associated objectives stated in their individual DelDOT divisions’ operating plans. To be consistent, strategic mission goals when mapped to published objectives within the DelDOT Divisions’ operating plans should correspond in general priority. Figure 7 shows that they do not correspond and therefore indicate a lack of alignment in priority ratings, that is, what is said is not what is done in practice.

Safety is the number one goal priority listed in the then current DelDOT Mission Statement (Figure 6), however, it is the third priority in the actual execution of objectives by the operating divisions (Figure 7). Environment and Quality of life which is the third highest strategic Agency goal, is last in operating execution. Cost effectiveness and efficiency is shown to be the highest objective within the departments and not safety, which is stated as the Agency’s primary objective. This creates a confused situation for planning. If cost effectiveness is the number one actual priority, there is risk of too much focus on how to do a project and less of why to do a project.
The Mission of the State of Delaware's Department of Transportation is to provide a safe, efficient, and environmentally sensitive transportation network that offers a variety of convenient, and cost-effective choices for the movement of people and goods.
Since transportation planning generally deals with many incommensurable variables, this can lead to a decision making environment focused on doing infrastructure projects efficiently that perhaps should not be done at all (Miller, 2010). This would appear to indicate that the long range planning process is different at DelDOT from the actual practical execution of planning transportation infrastructure at the operating level. DelDOT is, however, similar to other State Transportation Agencies in showing ambiguity and inconsistency in their prioritization and ranking relationships of their long range planning versus actual operations.  

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The review of the 50 State Long Range Transportation Plans (LRTP) in Chapter 5 confirmed the similarity to the DelDOT SLRTP showing a lack of consistency between stated goals and actual objectives. This was confirmed in the interviews with State Directors of Transportation Planning who pejoratively described SLRTP’s as “useless”, “worthless”, or “meaningless,” and unanimously agreed that their actual DOT operations and long range plans were not related.
The literature review in Chapter 2 documented recommendations from academic researchers, elected politicians and various transportation stakeholders on how to restructure and transform USDOT and FHWA funding programs, organization and planning processes to improve future outcomes. However, all the recommendations implicitly assume that there is consistency in the actual implementation of goals and objectives at the state and federal level, and that the long range plans regardless of methodology, are actually utilized in practice. The case study of DelDOT, the review of 50 State LRTPs, and the subsequent interviews of State Directors of Transportation Planning proved this assumption to be incorrect.

Delaware’s 2010 Long Range Transportation Plan “Moving the First State Forward” is a 20 year general policy based plan structured on the goals shown in Figure 6. In accord with its FHWA approved public participation plan, public meetings were held in each of the three counties for review and input before final approval of the 2010 plan by the FHWA. A collective total of 8 people (non-staff) attended the three meetings (.00087% of the Delaware population). The plan was approved by the FHWA. The DelDOT senior planner responsible for the long range plan and the public input forums indicated that this very low public turnout and attendance was typical. She expressed that 20 year long range transportation plans did not have much meaning to the general public. The public could not relate to something “that far out.”

Her reason for the lack of public interest is consistent with the beliefs voiced by the State Transportation Planning Directors in the structured interviews. Unless a transportation project has an immediate or compelling impact on an individual’s lifestyle, either positive or negative (NIMBY: not in my back yard), soliciting public
participation is difficult. Reviewing or considering options over 20 years or more in the future is not a current priority for the general public. The long range plan appears to be an amorphous document that lacks sufficiently compelling reasons for the public to take time to review it now. Therefore, the focus of the transportation agency becomes meeting the prescriptive federal requirement for having a plan. Getting through the public participation process is perceived as a burden to the agency and the objective is to get through it as quickly and easily as possible. The process becomes geared to meet the minimum requirements for approval, rather than a meaningful exercise to develop collaborative insight of societal planning needs and desires.29

In 2011 the FHWA John A Volpe National Transportation Systems Center reviewed the Delaware 2010 SLRTP and commended the State for having an implementation and monitoring section for assessing the effectiveness of its Long Range Plan, including “regular updates, monitoring and annual reporting of performance through disseminating a status report” (Volpe, 2011). As of August 2015, I found that none of the monitoring or annual update activities were done as stated in the Long Range Plan. This is consistent with the structured interview responses from the State Planning Directors that the Long Range Transportation Plans are not used in practice (See Chapter 6). Delaware will be required by federal statute to develop a new Long Range Plan in 2015 guided by the performance principles in MAP-21 (Public Law 112-141, Moving Ahead for Progress in the 21st Century Act, 07-06-2012), the principles that have not been completely released by the FHWA as of August 2015.

29 This perspective was voiced by all State Directors of Transportation Planning interviewed for the thesis research (See Chapter 6)
In late 2009, a proposal was put forth from the DelDOT Department of Planning to the Secretary of Transportation to address the problems created by this lack of focus in its Mission Statement and the non-functioning prioritization process. A change in any state agency mission statement in Delaware requires the approval of the Governor. In the Department of Transportation, both the Governor, the Council on Transportation (COT-public representatives appointed by the Governor), and the FHWA must also approve any change in any existing planning and prioritization processes. Approval was sought and achieved in early 2010 to investigate alternatives. A DelDOT study team referred to as the Performance Measures Hot Team was formed with representatives from all divisions of the agency and charged by DelDOT Secretary Wicks with developing a structure and process to plan and prioritize future infrastructure decisions and investments. A proposal was to be submitted to her for evaluation prior to the end of 2010.

I was a participant in that process. The team desired to evaluate state scale strategic prioritization planning concepts that incorporated significant public participation in the determination of value, and not the more finite technical planning programs used by DOT’s (including DelDOT) for highway and bridge infrastructure condition prioritization. The consensus of the study team after extensive review of other State DOTs prioritization processes was that none of them were deemed to be particularly useful or effective in actual practice. The approaches reviewed ranged from simple for/against majority voting processes to various combinations of voting and weighting schemes that generally lacked justifiable empirical basis for their selection. Although many were quite complex and had linear numerical prioritization ratings to three decimal places; there was a lack of justifiable significance to the precision. The processes and
plans looked impressive but lacked substance yielding misplaced concreteness. The study team work resulted in four major recommendations to the Secretary of Transportation. (Source: Internal DelDOT Hot Team Planning Recommendations letter of 9-2010):

1. Develop a new DOT Mission statement after having evaluated what the goals of the department should be when considered from the greater context of overall State and national priorities in and beyond transportation.

2. Select an agency performance measure and management process that links to the strategic goals. The Balanced Scorecard was recommended.\(^{30}\)

3. Implement a prioritization process that links to the goals and considers both values and preferences, not just technical and financial considerations. The Analytical Hierarchy Process (AHP) was recommended. (Refer to Appendix D for a complete description of AHP and its mathematical basis).

4. Meld long and short range planning into a continuous process with the use of scenario planning on a formal basis in conjunction with other state agencies.

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\(^{30}\) The Balanced Scorecard is a performance measures management approach originally developed by Robert Kaplan and D.P. Norton that looked at four perspectives in determining strategic direction: financial, customer, internal processes, and learning and growth. It was adopted in many service and non-profit sectors due to its emphasis beyond simple financial profit as a performance measure of success (Kaplan, R.S. and D.P. Norton. 1992 Harvard Business Review (January-February): 71-79.)
Two unique aspects of the recommendations were #1 and #4; working with other state agencies on integrated planning and prioritization and creating an agency specific mission statement in coordination with the other agencies’ goals. This came about after a team discussion on the subject of reducing highway fatalities. Figure 8 shows the police reported distribution causality for fatal accidents on the Delaware highway system in 2007 (latest data available at time of Hot Team deliberations).

-FIGURE 8-

Delaware Fatal Accident Causes 2007

Source: Data extracted from Delaware State Police accident reporting system 8/2010 by Michael Kirpatrick, DelDOT Planner.
Further analysis by the DelDOT Planning Department revealed that 85% of the root causes for these fatalities in 2007 were independent of the transportation system infrastructure, and/or its operations. Only 15% of the death causing accidents could reasonably be mitigated or prevented through process change or structural transportation network redesign, such as energy absorbing barriers versus solid steel guard rails or other countermeasures. The initiating events (root causes) leading to the overall occurrences of death were overwhelmingly not under the management control of the DOT or its physical infrastructure. It was discussed by the Hot Team that perhaps a better performance measure or goal might be all preventable deaths throughout Delaware. A quick, although not complete, analysis was done that demonstrated that using a portion of transportation safety funds for developing more kidney dialysis capability in the State could result in less net deaths in Delaware, versus spending the same or more funds within the transportation category. Usage and transfer of funds in this manner however was not possible as it would violate both FHWA and Delaware Transportation Trust Fund regulations; yet the action may have more effectively and efficiently achieved the desired outcome of less net deaths in Delaware. In this case existing state and federal regulatory and agency organizational regulations created in isolation between transportation and social/health services would force lesser quality outcomes by default.

The recommendations were approved by the Secretary of Transportation and the report forwarded to Governor Markell’s Staff that was working on Performance Management Measures for his review. The report was then approved by the Governor’s Performance Management working group and forwarded with their positive recommendation for approval to Governor Markell for his signature. Secretary Wicks
was advised in December 2010 by the Governor’s Chief of Staff that the report and recommendations were being embargoed. The explanation from the Chief of Staff was that the recommendations were far more advanced and radical than what had been proposed by any other state agency and might be inappropriate to release at the current time. Although several requests were made by Secretary Wicks to the Governor’s office for more detail on the reasons for the embargo, no further information was ever provided. Secretary Wicks resigned in March 2011. Her replacement Acting Secretary Cleon Cauley again made the same recommendation for implementation of the proposal to the Governor in May of 2011.\textsuperscript{31} He was advised that the proposal was now being held pending the Governor’s final decision on selection of a new permanent Secretary of Transportation. A new Secretary, Shailen Bhatt, a former USDOT Policy Analyst, was appointed in July 2011. Three of the four recommendations were ultimately approved for implementation one year later in August 2012. A new Mission Statement was released in early 2013 and the AHP process started on a test basis in late 2013. The recommendations for the use of the Balanced Score Card performance management methodology and scenario planning on an integrated basis with other state agencies did not move forward and was not implemented. No reasons were given for the rejection of this element. A program position was created in the DelDOT Secretary’s Office specifically for the management of internal, agency specific performance measures and limited to only transportation.

\textsuperscript{31} During this period of time DelDOT was under both Federal and State Department of Justice investigations. The Wilmington News Journal Newspaper ran repeated investigative reports on various improper real estate transactions, missing funds and other examples of DelDOT mismanagement. With the agency’s credibility being questioned it may have created a perceived political liability for Governor Markell and informed his decision. General elections were being held for State Senators and Representatives in 2010 with the run-up to the primaries and re-election campaign for the Governor in 2012."
DelDOT identified significant problems with its planning and prioritization processes and methodologies in 2006. Possible alternative solutions were explicitly developed in 2010. Formal implementation started in 2014 on a trial basis. The process required 8 years, 60% longer than the cycle time of their 5 year long range planning program. This DelDOT experience, the literature research and the subsequent interview responses of state transportation Planning Directors, all confirmed the tendency of State transportation agencies for slow or rejected acceptance of newer planning methodologies and decision architectures that better inform transportation policy options. The resistance to change came not from technological or financial limitations but rather from agency inertia, political issues (see footnote 31 pg. 67), isolated administrative state functions, and federal regulation that did not permit a recursive, integrated continuous long range planning process to operate in place of the discrete federal 1-4-5-20 year deterministic project program structure (1 year TIP- 4 year STIP- 5 year FISCAL CONSTRAINT PLAN-20 year+ SLRTP). The discrete single point estimate based long range transportation plan, done in isolation within an uncertain stochastic environment, can be successful only by random chance.

### 4.6 New DelDOT Practices in Planning and Prioritization

DelDOT began development of a new Mission Statement with separate vision statements and supporting goals under the direction of the new Secretary of Transportation in late 2012. The new mission, vision and goal statements were formally approved in 2013.\(^{32}\)

\(^{32}\) DelDOT Mission Statement, Vision Statements and Goals are available for review at http://www.deldot.gov/home/about/.
The Mission Statement is:

“To deliver excellence in transportation for every trip, every mode, every dollar and everyone.”

The Vision statements are:

1) “We strive to make every trip taken in Delaware safe, reliable, and convenient for people and commerce.”
2) “We provide safe choices for travelers in Delaware to access roads, rails, buses, airways, waterways, bike trails, and walking paths.”
3) “We seek the best value for every dollar spent for the benefit of all.”
4) “We engage and communicate with our customers and employees openly and respectfully as we deliver our services.”

The Goals are:

1. “Minimize the number of fatalities and injuries on our system.”
2. “Build and maintain a nationally recognized system benefiting travelers and commerce.”
3. “Provide every traveler with access and choices to our transportation system.”
4. “Provide every customer with the best possible service.”
5. “Minimize the environmental impact of the state’s transportation system.”
6. “Achieve financial sustainability through accuracy, transparency and accountability.”
7. “Develop and maintain a place where talented and motivated employees love to work and can be national leaders in transportation.”
With the new Mission Statement, Vision and Goals structure, the Agency elected to test the Analytical Hierarchy Process (AHP) methodology for prioritization on a trial basis beginning in the winter of 2013. This is the first time since 2006 the agency would be in compliance with its own State regulations (Delaware Code Title 29 Chapter 84 Section 8419) for having both a method of determining current needs and costs for the entire multi-modal transportation system, and a formula based process for setting priorities. The eight years of non-compliance did not result in any penalties at either the state or federal level. As of August 2015 the agency still has not transitioned into full implementation of the new AHP prioritization model. The AHP methodology is being used selectively to augment the older process and is considered in “Beta test” and still lacks public input on the determination of value preferences and their importance.

The current necessary strength of preferences and criteria inputs needed to implement the AHP methodology and achieve the “excellence” per the DelDOT Mission Statement and Goals were developed only by the Secretary of Transportation and Senior Staff of the Agency. A test run of the created AHP model was done with a subset of the Council of Transportation (COT) to compare preferences. The COT is an independent 9 member citizen advisory group appointed by the Governor to oversee DelDOT’s financial affairs and prioritization of projects. The Director of Planning indicated that the results were consistent between the ratings done by the 4 COT members and the DelDOT Senior staff’s ratings (detailed data was not made available to the author). The long

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33 The subset of 4 Council members involved with the test included a male owner of a major automobile sales franchise in Delaware, a male engineering manager for a consulting firm that held current DelDOT contracts, a retired male minister, and a male retired citizen. Although both groups yielded similar preferences in the AHP test, given the composition of both groups it is questionable as to the developed preferences being free of bias and actually representative of the larger general Delaware population.
term plan is to incorporate the preference and criteria setting process at all levels of the agency, MPOs, and the public, on a continuing basis thus providing for evolutionary learning and a recursive seamless short and long term planning process. This new AHP based prioritization and planning approach if fully implemented will still be required to mesh with the episodic federal TIP and STIP transportation planning process and therefore will require “snapshots in time” to create the more static federal plans to be in regulatory compliance and qualify for federal funding.

DelDOT created initial weightings or preference values for the 7 criteria required under MAP-21 and their own state code requirements. See Appendix E for a complete detailed listing and description of the DelDOT project criteria and ratings program. The DelDOT preference weightings for the seven criteria currently being tested are:

a) 33% Safety
b) 24.8% System Operating Effectiveness
c) 15.6% Multi-modal Mobility, Flexibility/Access
d) 7.9% Revenue Generation/Economic Development/Jobs & Commerce
e) 7.2% Impact on the Public/Social Disruption/Environmental Justice
f) 6.5% Environmental Impact/Stewardship
g) 5% System Preservation

Each criterion has a relative performance measure weight scaled from 0-1 associated with a project’s impact on the variable of interest. For example criterion f) Environmental Impact/Stewardship has a rating scale that is applied in the evaluation process to each infrastructure project and its specific environmental/stewardship impact rated as follows:

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34 System preservation primarily is for preventive maintenance activities that prevent the loss of an existing functioning asset, but does not expand its current functional or design capability (repave a highway section, replacement of bridge components, etc.).
1.0 Positive Impact
0.5 No Impact
0.2 Minor Impact
0.0 Major Negative Impact

As of August 2015 the determination of what constitutes a relevant performance measure and its weighting is still being done in a quasi-Delphi method by only DelDOT project managers in consultation with the Director of Planning and the senior staff of the Secretary of Transportation. The current criterion weightings and relative performance measures are still vague and can be considered a work-in-process.

On February 20, 2014, I interviewed Mr. Drew Boyce the DelDOT Director of Planning. He mentioned two conclusions he drew from the running of the Beta AHP prototype model that he characterized as “surprising.” The first was the Frederica - Route 1 grade separated interchange project, with an estimated cost of $23.5 million. It had for more than 15 years been a high priority top 10% project. In the new AHP based analysis it now was rated 98th out of 109 projects, and was now in the bottom 10% of priorities. The other surprising conclusion, with projects now aggregated together for comparison purposes regardless of mode, scale, or funding group, was that a collection of smaller and diverse infrastructure projects appeared to better achieve the outcomes desired by the agency, rather than doing a few “big ones.” Initial research on limited sample data in 2010 by the Hot Team Performance Measures group indicated this might be the case; smaller projects when aggregated together, better achieved desired outcomes, than isolated “big” projects. The AHP analysis in 2014 with the complete DelDOT project database confirmed that insight. The entire approved 745 page project program
can be found at http://www.deldot.gov/information/pubs_forms/CTP/index.shtml under the FY14 - FY19 Capital Transportation Program (CTP) tab.

Mr. Boyce, who implemented the AHP prioritization program, indicated during the interview that projects which previously had a well defined objective, and with outcomes that solved significant safety and operating issues, continued to rate highly with the new AHP methodology. With 57.8% importance rating developed by DelDOT management for the AHP model going to the safety and system effectiveness criteria this is to be expected for well defined projects with highly correlated performance outcomes. The greatest change in priority was found for projects with ill-defined original problem statements, lack of identifiable salient preferences and/or significant changes in previous assumptions of future conditions. In the case of the $23.5 million dollar Frederica - Route 1 grade separated interchange; its priority was estimated in the late 1990s based on projected VMT (Vehicle Miles Travelled) from population growth estimates, and a correlated accident incidence, that never materialized. The project remained static in its ranking with an assumed, but outdated, high priority since no prioritization methodology was in place from 2006 to 2013 that updated with newer information to recalibrate the project’s importance. The AHP model demonstrated how the new calibration of the Frederica – Route 1 project’s relative contribution to desired overall system performance was less effective than allocating the $23.5 million to a multitude of smaller projects, given newer acquired knowledge. Some DelDOT engineers initially referred to this situation as a zero-sum game (wins equal losses). In reality it was not a zero sum game, and the use of AHP demonstrated that greater performance outcomes could be achieved at the same or lesser expenditure of funds.
The discrete and static infrastructure project lists previously used by DelDOT had no integrated comparison of outcome effectiveness or efficiency across all projects and programs. The static lists were continuously aging and became more detached from reality over time, with financing ability being the only criteria considered to start an approved project as time progressed. The current DelDOT Director of Planning noted that the use of AHP required the engineers and planners to place greater attention on actual problem statement definitions and refinement of expected outcomes, as even the first few iterations of the AHP model led to questions of “why are we doing this project?”

4.7 Synthesis, Conclusion and Recommendations

The specific case study of the Delaware Department of Transportation revealed results that were in general agreement with the conclusions subsequently developed from the data collected from the phone interviews with the State Transportation Planning Directors. The case study affirmed the assumption that DelDOT’s Long Range Transportation Plan was generated to meet federal requirements for funding and not actually used as a policy planning tool in Delaware.

The implementation of AHP by DelDOT, even in a Beta test mode confirmed that at an operating level, improved methodology can have a positive impact on determination of strategic direction and policy decisions. DelDOT planning management discovered that with an improved planning and prioritization methodology, insights that had been hidden for several decades suddenly became more evident. In the DelDOT case when the surface transportation network was examined as a whole in a structured reproducible format, with all possible outcomes compared to each other and not isolated by type, net
better performance was indicated by doing several smaller projects rather than a single large one. With previous projects, regardless of scale, categorized only by type and restricted to prioritization within a type, there was no opportunity to appreciate and "discover" this insight.

By pre-prioritizing projects into categories or silos based on federal guidance, referred to by the state planners as “the color of money,” no opportunity was afforded to see the interdependence of outcomes beyond a random casual inference. Implicit assumed priorities were being set that created pre-prioritization before actual prioritization and created a circumstance where the potential whole was less than the sum of its parts. Implicit and explicit priorities being set at the federal level can be appropriate, however, the literature review demonstrated that there is significant disagreement and confusion as to what those actual priorities are, or should be in practice. The AHP methodology, albeit not fully tested for this purpose, eliminated these artificial barriers and permitted a more holistic transportation evaluation. With a new methodological approach (AHP), the potential now exists where the sum of the individual outcomes has the opportunity to be greater than the original assumed whole, from a policy perspective. The AHP approach in this example provided tangible evidence that a "one size fits all" federal policy for pre-determining categorical program and project priorities with discrete planning processes for a state, may not be in the best interests of

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35 The phrase “Color of Money” used by DOT staff refers to the federal categories of financial support that can only be used for explicit designated purposes (highway versus bridge funds), regardless of state needs or priorities, the funds are not permitted to be redirected.

36 Although the analysis is now more holistic within transportation at DelDOT, the systems approach and use of AHP as implemented is still confined within one state agency and the USDOT-FHWA architecture and does not take into account opportunities that may exist beyond the bounded artificial administrative divisions.
achieving desired aggregate overall outcomes on either a national or local scale. There is therefore logical inconsistency of objectives even within its own regulatory context.

When there are hundreds or thousands of projects under consideration for prioritization and funding, an organized methodology should be employed that can consider them collectively, react to new information, and provide a consistent structure in a repeatable format to determine progress over time. In this case study, the application of the AHP approach helped DelDOT to determine what alternatives best achieved their collective desired objectives within the federal regulatory context, and for the least expense. Although still very limited in scope, scenario analyses were created and the process considered new information and changing preferences thereby providing additional insight for creating more robust and flexible policy options on a continuing basis. This capability did not exist prior to the implementation of AHP.

The new approach to prioritization and long range transportation planning by DelDOT is an incremental improvement over past practices. Its ultimate success, however, is still very limited by issues that have yet to be addressed:

1. The evaluation of priorities and individual importance for long range transportation policy options continues not to involve the public in any meaningful way at the current time. The public did not have any input into the initial or current AHP model preferences and ratings. The AHP application as currently implemented by DelDOT does not take advantage of the graphical presentation capabilities for public meetings to show in real time, the implications of various priorities and preferences on desired outcomes as people “vote” their individual preferences, and create a basis for constructive
dialog and discovery. It appears that the engineering culture is still dominating the dialogue and framing the discussion.

2. The application of the new AHP model is being applied to a collection of transportation programs and projects that were originally developed using single point deterministic estimates of future requirements and project selection, made with an acknowledged “mathematically corrupt” prioritizing formula, going back over 15 years. This may be a circumstance of prioritizing the best of the worst, as opposed to prioritizing the best from the best. The starting point is questionable.

3. Transportation infrastructure prioritization and policy development is still restricted to the transportation agency and is not integrated with any other state agencies. Long and short range planning in Delaware is still falling far short of its holistic potential by artificial administrative boundaries.

4. The long range transportation plan and long range planning process is still considered a separate activity within the agency and the planning department, and not linked in a functional recursive way to any short term planning in the agency. It is still treated as a “check-off” for federal funding purposes and not for informing more beneficial policy development.

The overarching recommendation resulting from this case study is similar to the recommendation made over 7 years ago by the internal DelDOT Hot Team: integrated scenario planning involving other state agencies. The recommended approach would not usurp individual authority or contradict any existing federal guidelines from any federal
agency. It would however make use of the data available across agencies and view it in a more holistic perspective to generate better insight for improved policy recommendations. The results generated may clash with existing administrative boundaries, as happened in the past at DelDOT. However, the weight and clarity of evidence may also provide a tipping point to motivate change. Given the data available across Delaware State agencies and the computer capability at DelDOT, AHP alone or in conjunction with any of the multiple -criteria decision making approaches identified in the literature review, may better deal with uncertainty, risk and value determination than previous approaches, and help create more robust policy options for the State of Delaware’s consideration.
“Doing a long range transportation plan is like having a baby. Once you have been through it, you don’t want to have to do it again for a very long time.”

Sandy Beaupre
Wisconsin Director of Transportation Planning 2011

-CHAPTER 5-

ANALYSIS OF STATE LONG RANGE PLANS

5.1 Introduction

In order for a State to receive federal transportation funds it must have a current, approved long range transportation plan (SLRTP). The plans must have a minimum twenty year planning horizon, and be updated at least every five years. This component of the research focused on how the plans have evolved since becoming a federal requirement in 1991. An analysis of the state plans sought to answer four questions:

1) What kinds of long range plans are being developed?

2) Has there been methodological innovation over time, and are those advancements being utilized in the policy development process?

3) How are policy variables prioritized in decision-making and what methods are used to determine the variables of interest?

4) What time horizons are utilized in the planning process, and how does this affect the transportation policy decisions developed?
5.2 State Long Range Transportation Plans: Types and Timeframes

For evaluative purposes the Federal Highway Administration categorizes state long range transportation plans (SLRTPs) into six types:

1. **Policy**: Plan based on overarching policy positions to accomplish future results (safety, mobility, economic development).
2. **Needs**: Plan considers existing infrastructure and identifies needs based on trends and projections using analytic metrics such as level-of-service (LOS).
3. **Vision**: Plan based on overarching strategies or philosophies to achieve desired outcomes.
4. **Project**: Plan identifies and lists specific projects and the funds needed to build out the plan.
5. **Corridor**: A combination plan of #2, 3, and 4 above divided into primary geographic corridors of transportation modes for freight and passenger needs.
6. **Financially Constrained**: A plan for a transportation system driven by fiscal constraint.


Although one category may be the main focus of a plan, the plans generally are a combination of several categories unique to each state. Prior to 1991, long range plans were primarily schedules of anticipated future projects to be constructed, based on the linear projection of future population and transportation infrastructure capacity needs. In 1991, federal guidance required a shift from a project orientation to a program
orientation. After 2000, long range plans started to migrate increasingly away from the project orientation. Figure 9 shows the distribution by classification types of the 50 SLRTPs as of 2011. 57% of the states had moved away from a project orientation to policy based long range plans in 2011. This migration was accelerated by increasing acceptance that there were insufficient funds, either at a state or federal level, to actually execute all of the originally planned projects. Transportation agencies could not be accused of never completing their planned projects, if there were none in the long range plan. This appeared to be a more politically acceptable approach to long range planning. It was easier to defend broad policy positions to the public rather than the failure to fund explicit anticipated, previously projected future projects. However, it is not clear from reviewing the 50 SLRTPs if this migration to a policy based structure improved the quality of the long range planning process.37

According to 23 CFR § 450.214(a), “The State shall develop a long-range statewide transportation plan, with a minimum 20-year forecast period at the time of adoption, that provides for the development and implementation of the multimodal transportation system for the State.” As of 2015, 32 states use the minimum 20 year horizon, 15 use 25 years and 3 use 30 years. Some consideration is being given to 50 year horizons, however, there are no indications of a strategic shift in the next generation of 5 year updates to longer planning horizons. The exception appears to be for structural issues in the definition and calibration of 100 year storm events for disaster planning and design criteria for bridges.

37 The State Directors of Transportation Planning in my research survey all responded that their next SLRTP will be “vision” based. Not because it is a better long range planning approach, but because the document is shorter in size, easier, faster and cheaper to produce, and reduces the risk of being “wrong,” and not being accused of not completing listed projects.
One primary approach was identified by the Volpe researchers that best represented each plan’s approach. The District of Columbia is included in the Volpe data therefore yielding 51 plans.

The plans all discuss the uncertainty of trying to forecast funding over long time frames, as well as population and patterns of development beyond a few years. All plans prior to 1991 were forecasts of broad building schedules and desire rather than the consideration of scenarios over long time frames capable of being responsive to unknown future changes. The SLRTPs prior to 1991 could more accurately be described as schedules, rather than planning documents. Prior to 2011 the chosen planning time horizon had little meaning. It was not considered an integral part of the analysis, since most variables of interest were simply linearly extrapolated. The Volpe Study data in
Figure 9 shows that 57% of the states had moved to a Policy structure for their SLRTPs by 2011. However, the planning horizons were still not linked or coupled to the policies as an integral planning parameter of interest. Nothing could be found in the plans, or the literature, that asserted a substantial justification for the benefit of one specific time frame over the other for using 20, 30 or 50 year planning periods.38

5.3 SLRTPs: Missions, Goals, and Objectives

SAFETEA-LU, the transportation funding bill passed by Congress in 2005, required six primary goal areas to be considered for the expenditure of federal funds at the state level: Safety and Security, System Preservation, Efficient System Operations, Environmental protection, Connectivity and Economic Development. I reviewed the 50 SLRTPs to see, if in fact, these goal areas were being considered, and their priority at the state level versus the federal guidance. A frequency histogram was created of the most used words and their related variants from a state’s transportation mission statement and goals for each of the 50 states. The results are shown in Figure 10. It can be inferred that the frequency of the occurrences for the individual descriptive words in the mission statements summed across all states reflects the relative collective national consensus of priorities from the states’ perspective. Safety is number one (72%). The next four goal preferences are relatively equal (states concurring 38-49%). The balance of priorities quickly trends down to 27 unique occurrences used only by 1 or 2 states (2-4%). Only 6 of the 27 different unique occurrences are shown in the histogram.

38 The State Directors of Transportation Planning in my research survey consistently expressed their desire for shorter time periods for doing long range plans due to the uncertainty in their ability to forecast future events and financing. This seems to indicate confusion in understanding the differences between forecasting versus planning, and the differences in long range versus short range planning, and their relationships to each other.
Within the USDOT, State DOTS, and their professional organization AASHTO, there is significant, although not universal agreement that in surface transportation the performance measure for safety is deaths per million miles of VMT (Vehicle Miles Travelled). For the next four most frequently identified State level priorities, there is no consistent or universally accepted definitions or performance measures for what constitutes success. This finding from reviewing the long range plans is consistent with what the literature search revealed on the lack of objective measurements generally, to
evaluate the effectiveness of federal investments made over the last quarter century in transportation infrastructure. Without relevant measures of success there is no basis by which to determine policy option quality over time. In other words, how do you know if you are achieving your mission and goals?

Performance measurement is the consistent application of selected measurement variables that are representative of the effectiveness and/or efficiency of a program, policy, process, or system. In 2002 only twelve state long range plans specified any type of specific performance measures. In 2011, nine states had established performance measures to prioritize infrastructure projects, with twenty-one states having limited initial measures being developed (Volpe 2011).\(^{39}\) With the implementation of MAP-21 in July 2012 all states were required to have performance measures as part of their strategic planning. Federal guidelines for the first performance measure on Safety however have not been issued as of August 2015.

SLRTPs translate their primary mission statement goals as shown in Figure 10 into their operational guiding principles as shown in Figure 11. Figure 12 maps the goals from Figure 10 to the guiding principles from Figure 11. Mapping ranked goals to ranked guiding principles should show a direct one-to-one correspondence if there is consistency in priorities. The data presented in Figure 12 shows this is not the case. Except for safety, at the state level, there is divergence and inconsistency in the ranking of principles in valuing future long range policy decisions versus stated mission. When there is

\(^{39}\) Trends in Statewide Long-Range Transportation Plans, (Volpe op. cit. ppg 26-33). The measures in the plans varied from explicit analytic surrogate measures for safety as deaths per million vehicle miles travelled, and percentage of bridges rated fair or better in structural condition, to measures of personnel performance given as a percentage of employees trained in prescribed state code requirements. There was insufficient data presented within the plans to make a determination on the utility of these measures and their impact on future policy development.
divergence between mission goals and operating principles, confusion is created in policy priority setting. In essence, one thing is said, and another is done.

-FIGURE 11-

Reviewing only twelve SLRTPs in 2012, Mansfield and Hartell found similar results.\textsuperscript{40} Performing a content correlation and regression analysis, they found virtually no correlation between the policy framework and plan development, coordination or assessment (r values of 0.173, 0.180 and 0.004 respectively). Similar low correlations

\textsuperscript{40} Six of the States studied by Mansfield and Hartell were also represented in the structured interviews conducted by the author. (Mansfield, Theodore J. and Ann M. Hartell. 2012. Institutionalizing Sustainability at the Level of State Departments of Transportation: Quantitative Assessment of Transportation Sustainability Plan Quality. \textit{Transportation Research Record: Journal of the Transportation Research Board}, No 2271, pp 9-18. Washington, D.C.)
were also noted for internal consistency and state mandates. These findings are not surprising given that the literature research demonstrated that there has been on-going policy ambiguity for approximately the last 25 years in transportation planning. Although safety is generally considered the highest priority, the meaning of what safety is, and its measurement, is still being debated. Quality of Life shows the greatest divergence in priority focus in the current analysis. Beyond clean air and clean water to sustain life, developing consensus of what constitutes a quality of life for public policy is a difficult social/behavioral science task apparently made even more difficult by trying to devise transportation policy from a primarily engineering perspective. In 2013 the combined fifty State Long Range Planning Transportation Plans composed 10,295 pages with a mean length of 206 pages.

The research phone survey responses from the State Transportation Planning Directors indicated that SLRTPs are not used in practice. Beyond the direct financial costs, it begs the question as to how might the resources consumed in producing 10,295 pages of unused documentation be otherwise fruitfully utilized for long range planning? In 20 years (1991-2011) a majority of SLRTPs moved from a project to a policy orientation. Now in the next 5 years a majority are moving from policy to vision based SLRTPs. The first major movement away from project to a program orientation was

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41 The FHWA and State DOTs have traditionally measured highway safety in deaths per million miles of travel. However, is highway travel safer if deaths go down while debilitating injuries go up? What if more pedestrians and bicyclists are injured and not accounted for in the data collected?

42 Responses from the phone survey research indicate that for the States surveyed all are moving to vision based SLRTPs in their next update cycle; a departure from the previous policy based majority. Respondents uniformly indicated that “shorter was better” for the next generation of vision based SLRTPs.
instigated by a federal requirement. The second transition appears to be motivated by a lack of funds, staff, and apparent need to minimize political risk.\textsuperscript{43}

The State Planning Directors surveyed uniformly responded that simplification might enhance public participation if the long range plans were shorter and easier to understand by non-professional participants. However, that assumes that what is presented for public consideration is based on valid methods of development. The phone interviews of the state directors of planning indicated that this is not currently the case. The linear rational predict-then-act planning philosophy being used for the basis of the long range transportation planning process dialogue with the public is based on assumptions, contexts and framing that has been demonstrated to be unreliable. This situation then constrains potential insight from participants in the planning process. In addition to limiting insight, the greater risk may be of developing faulty insights due to the distorted framing of the discussions.

5.4 Synthesis and Conclusions

This avenue of research did not yield the anticipated results expected through analysis of other states best practices for improving overall long range planning. The individual State Long Range Transportation Plans (SLRTP) did not demonstrate practice methodologies that could be considered substantially better in quality of one approach over another given the contextual difference in the states. All plans began with the linear predict-then-act rational planning approach in setting their initial planning assumptions prior to creating their SLRTP; regardless of subsequently utilized methods. All the plans demonstrated inconsistencies between mission, goals and objectives, regardless of their

\textsuperscript{43} My interviews of State Directors of Transportation Planning yielded results very similar to the 2002 Handy research study on the specific desire of planners to avoid political risk (Handy, op. cit.)
The review of the plans coupled with interviews with the State Directors of Transportation Planning confirmed that SLRTPs are essentially documents created to meet a federal requirement to have a plan, although not necessarily a useful or meaningful plan. The migration to smaller vision based plans is being motivated by limited resources and a desire to avoid political risk, and not because the approach can be shown to be an improvement over past practice.

If one accepts that long range planning can be a useful policy tool when properly executed, then this component of my research demonstrates that current long range transportation plans as required by federal statute are not useful. The surveyed State Directors of Transportation Planning, the people responsible for their LRTP development, explicitly stated that these plans are not utilized in practice, and are disjoint from, and not integrated with, their short range state level transportation planning, notwithstanding published federal and state documentation stating otherwise.44 Currently, therefore it does not appear to matter what type of plan approach or time horizon is being utilized for a long range transportation plan since the plans are not used. However, my review of the plans was essential in order to be fully informed prior to interviewing the State Directors of Transportation Planning on the research subject matter.

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44 Refer to Appendix F for the specific responses by the transportation Planning Directors to interview questions 5 through 9 on the utility and effectiveness of the SLRTP and their perceptions on the planning process.
6.1 Introduction

The phone survey component of the dissertation research was designed to help better understand the current state of affairs in state long range transportation planning and where the emphasis for policy change should be from people on the ground and most responsible for state long range transportation planning and execution. Gaining this insight could help identify the potential that improved process changes might bring in the quality of long-range planning outcomes.

Appendix A contains the survey instrument set of 24 questions. The questions were divided into four groupings: Part One with 6 questions on state planning process and organizational considerations, Part Two with 6 questions on planning perceptions, Part Three with 5 questions on planning methodology considerations, and Part Four with 7 questions on demographic and personal reference data. At the start of each phone interview, Part Four questions 18-24 on respondent demographic and reference information were asked first as there was a risk of the phone interview being cut short by the interviewee due to unscheduled work demands. Slightly truncated interviews did occur with three respondents. Questions 1-17 were then asked in sequence, followed by unscripted closing comments, if any, time permitting. The sequence of asking the four
question groups was not varied in the individual phone calls. This was done for two reasons; 1) Part Four, the demographic and reference information was essential data and easy to respond to quickly, and 2) for Parts One and Two on Process and Organization, and Planning Perceptions, in the original development of the survey I expected responses to be rather short in nature and an appropriate lead-in for Part Three on Methodology. In practice this proved to be generally the case. I originally thought the issues on Methodology Considerations in Part Three would require more time to ponder before answering as compared to the questions in Parts One and Two; particularly so for questions 14 to 17 on climate change, planning horizons, plan philosophy and the 8 SAFETEA-LU planning factors. Time being of the essence to the respondents, I wanted to have as many questions answered as possible given the time constraints. Therefore the sequence was not varied.

The original phone survey was thought to be able to be completed in 30 minutes. In practice the shortest conversation was 40 minutes and the longest 165 minutes. Only six interviews were under 1 hour in length. A total of 34.3 hours of survey time was expended in direct dialog with the respondents on the 24 questions. The length of the conversation on any given question varied greatly based on the particular personal focus or interest of the respondent. The respondent set the pace for the speed of the overall interview and time spent on each question based on their personal scheduling needs and interest. Regardless of the length of the call, in no case was there any indication of attention loss or disinterest by any respondent during the interview process. To the contrary, every Director interviewed appeared to enjoy the dialog and the opportunity to voice frank opinions on the issues. Although informed at the beginning of
the call that the interview was not being recorded, every Director asked at least one more time during the interview to reconfirm that responses were not being recorded. This occurred where the opinion expressed was in significant conflict or disagreement with their management’s stated policy position, and/or a federal/state policy directive, and therefore might create difficulty for the respondent if publicly disclosed.

The validity of the research effort was not materially affected by the lack of complete participation from all 50 states. The parallel evaluation of the entire universe of 50 state long range plans did not uncover any elements that conflicted with the planner responses in the phone survey, or the conclusions drawn from the literature research. The Directors of Planning in the completed survey pool represented States collectively equaling 55% of the total square mile area of the United States, 55% of the population, 48% of the total rural highway network, 54% of the total urban highway network, and 53% of the total federal transportation funds allocated under MAP-21 for Fiscal 2013. Therefore from a phronetic and geographic perspective even if the conclusions drawn from the survey data are not used normatively for the balance of the United States, they are significant in and of themselves, and a valid basis upon which to draw conclusions and make recommendations for the represented states.\footnote{The phronetic perspective as used here is Flyvbjerg’s interpretation of applied phronesis: wisdom that comes from an intimate familiarity with the practice contingencies and uncertainties in a contextualized setting (Flyvbjerg, 2012).}

The surveyed states represent all aspects of the physical geography of the United States except for the “island” of Hawaii.\footnote{The Delmarva Peninsula is technically an island and DE, MD and VA were surveyed.}
Figure 13 identifies the 26 states that formally participated in the survey, the 5 informal state contacts, and the 1 formal state rejection.47 Important individual findings drawn from the responses are presented in Section 6.2. In Section 6.3 the findings are analyzed in more detail as to interpretation and implications on recommendations for effecting change in future state level long range transportation planning. In Section 6.4 conclusions are presented from the analysis of the data.

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47 Informal phone contacts were made just prior to the start of the completed survey protocol. In those instances where an explicit question was posed that matched the final protocol question, the response is included in the data analysis and noted for the applicable questions in sections 6.2 and 6.3.
-FIGURE 13-

States Contacted and Status

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<tr>
<th>States Participating</th>
<th>Informal Participation States</th>
<th>Direct Rejection</th>
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<tbody>
<tr>
<td>1. Alaska</td>
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<td>1. Iowa</td>
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<td>2. Arizona</td>
<td>2. Minnesota</td>
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<td>3. Arkansas</td>
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<td>5. Delaware</td>
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<td>8. Kansas</td>
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<tr>
<td>9. Maine</td>
<td>Of the 18 states not participating, 13 never responded to any email or phone follow-up.</td>
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</tr>
<tr>
<td>10. Maryland</td>
<td>5 states responded with referrals to other personnel who either never responded or cancelled multiple appointments before the survey period ended.</td>
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<td>11. Massachusetts</td>
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6.2 Important Survey Findings

Fourteen important findings were developed from the responses. Except for the first finding, the order of the listing is not intended to indicate a ranked order of importance. The numbers in parentheses following each finding represent the number

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48 Appendix F contains summary data for all individual responses to each question asked in the phone interviews.
of respondents that explicitly stated this perspective in their interview, followed by the number of total of responses to the question. The 14 important findings are:

1. State Long Range Transportation Plans for almost forty years have been produced to meet regulatory requirements to assure availability and access to federal funds and not for informing policy decisions at the state practice level. They are not utilized in practice, are disjoint from, and not integrated with, shorter range state level transportation planning; notwithstanding published federal and state documentation stating otherwise. (31 of 31)

2. The plans are held in low esteem by the planning units that produce them and the state transportation engineering departments that are supposed to follow them. (26 of 26)

3. Linear extrapolation of historical trends used to guide long range transportation plan development is considered completely ineffective; yet 68% of Directors indicate they will continue to use this methodology for their long range plan development in the absence of knowing what else to do. (31 of 31)

4. Preference is for a continuous planning process, not episodic as required by the FHWA and the federal regulation for a “singular buildable plan.” (26 of 26)

5. A federal policy of “one size fits all” regulation fails to appreciate the scale of a state’s diversity and artificially limits performance potential for goal achievement. (26 of 26)

6. Respondents emphatically expressed that there is no relationship between local land use planning in their state and state level long range transportation planning. (24 of 26)
7. Although public participation is considered a hallmark of the USDOT and the FHWA in their functioning, all planners expressed the opinion that the prescribed public involvement process is completely dysfunctional and highly ineffective. (31 of 31)

8. Personnel charged with long range transportation planning at the state level are deficient in key knowledge and skills necessary for conducting long range planning; particularly in economics, planning methodologies, and communications. (26 of 26)

9. State Planning Directors have little or no knowledge of long range planning methodologies outside of transportation; and then surprisingly very limited knowledge even within transportation. They are aware of this and frustrated, but feel they have “no time” to do otherwise, even though they wish they could. (31 of 31)

10. Safety is the only planning factor of the eight required for State long range plans by the Federal Government that all the surveyed planners feel qualified to address and improve. (26 of 26)

11. Future SLRTPs will be primarily vision based because they are easier and less costly to produce and pose virtually no political risk; not because of any methodological merit, if any, over previous utilized approaches. (26 of 26)

12. The public has either none, or a very low level of trust in their state transportation planning departments and the long range plans that are produced. (31 of 31)

13. There are continuing gaps in language and philosophy between State transportation Planning Division planners and their engineering counterparts in
construction and operations in understanding and determining public needs and
total. (26 of 26)

14. Planners’ practice knowledge for doing long range transportation planning or
managing comes almost exclusively from in-house or “on the job training” and
not from their undergraduate college education. (26 of 26)

6.3 Analysis of Survey Findings

Except as noted in finding #6 above, all the important findings represent
complete 100% convergence and agreement in responses from the interviewed State
Directors of Transportation Planning both formal and informal. This degree of
convergence was not anticipated in the original formulation of the phone survey. It was
implicitly assumed that there would be less agreement in the data collected, with a
broader diversity of opinions and perspectives voiced by the respondents to the questions
given the diversity of the geographic, demographic, political, and economic
characteristics among the states and backgrounds of the respondents.

The backgrounds of the 26 planning directors interviewed were 35%
engineering and 65% non-engineering. On a national basis for the 50 states, 48% of State
Directors of Transportation Planning are engineers and 52% are from other professional
backgrounds. Responses proved to be independent of gender, age, education, time within
profession or job position, and nature of the area where individual grew up
(urban/rural/suburban).

All respondents expressed that the continued lack of an explicit national
transportation mission statement has resulted in perceived misguided objectives and
funding imbalances across states preventing them from doing the “right thing.” This has led to a very negative view of the federal long range transportation planning regulatory process with the policies being considered too rigid and not scale sensitive to the uniqueness of an individual state’s needs. The planning directors all desired do to a more effective job yet felt constrained in their efforts by the multitude of federal programs and the “color of money” associated with them. This circumstance led to infrastructure choices at the state level that were discordant at times with their own state priorities. The planners felt pressured by political and internal organizational stress to “not leave any money on the table,” regardless of existing contraindicated planning and policy decisions in the TIP, STIP or SLRTP.\(^{49}\)

Public participation programs were considered dysfunctional and only a “check off” to achieve funding and pass NEPA requirements, if required. All respondents indicated that their state civil service planning personnel job descriptions had evolved from the engineering ranks in their DOT. They felt these descriptions were outdated with misguided requirements limiting their ability to hire personnel with more appropriate skills and knowledge for improving planning and public involvement activities. Expert knowledge in communications, economics and planning methods were identified as being the primary areas of educational weakness.

\(^{49}\) For example if federal bridge funds were available, a bridge project would be started, even though it was a lower state priority than another project which required unavailable highway designated funds. In one case a high priority subway improvement could not go forward as the funds for “access ways” to the subway could not be used as the access was not defined as part of the infrastructure for mass transit. The access ways were steps, and handicapped capable elevators. The most common cited example was replacement projects would be started to replace/upgrade existing infrastructure prior to its actual end of life need due to funds being available currently. This led to inefficient use of funds by truncating the actual use life of infrastructure on an ongoing basis, creating an expansion of future problems by continuous shortening of infrastructure asset life cycles.
The production of state long range transportation plans based on an ineffective methodological approach that has gone on for decades was readily admitted to by all the interviewed practitioners. This continuing situation appears to be the result of three primary factors:

- plans are not being used as a policy resource in practice, so whether they were accurate or meaningful became irrelevant
- planners had no practical experience or functional knowledge of available alternative methodologies that were superior to the linear extrapolation rational predict-then-act planning models
- plan’s primary purpose evolved to only a check-off necessity to qualify for continued federal funding and not a functional aid for informing policy decisions. Approval became more important than the original purpose of informing policy decisions.

Although the 50 State DOT Planning Departments vary significantly in their staff sizes, they are quite similar in primary function and organizational structure. They typify “organizational isomorphism,” where over time bureaucratic organizations assume similar form and practice leading to limited perspectives on how problems are approached and solved (DiMaggio, et al., 1983). In long range transportation planning, political and career risks are avoided by sticking to the safe, if ineffective, linear predict-then-act approaches used by all other federal-state participants in the long range planning process, and in so doing not upset the status quo.
Doing a long range plan is perceived as a burden. None of the Directors indicated that long range transportation planning was considered a priority in practice by their respective state Governors for informing future policy decisions (notwithstanding public comments to the contrary). Since the plans were not utilized in practice, the primary focus of agency management was to get them done and out of the way as quickly and cheaply as possible for another 5 years.

Of the 628 cumulative years of professional experience represented by the respondents, 95.5% of total career experience was limited to transportation and 88.2% had no experience outside of their transportation agency employment. In the survey the career experience outside of transportation of 28 years came from only two respondents (20 years for one and 8 for the other). Individual experience was highly vertical in scope and limited to one industry and one employer in that industry.\(^{50}\)

The survey respondents uniformly replied that their undergraduate education did little to prepare them for managing or doing long range transportation planning, regardless of educational curriculum. All respondents indicated that the predominance of their practice knowledge came from on the job and in-house training and experience. The careers of the respondents are shown to be overwhelmingly limited to transportation generally, with long term tenures in their individual state agencies specifically. All the respondents stated that they had no knowledge or awareness of alternative planning methodologies outside of transportation, or beyond the linear extrapolation predict-then-act methodology. This raises a question as to how effective long term in-house training or “growing your own” as one Director called it, is for long range planning practice, given that all the respondents indicated that their undergraduate and graduate education did not

\(^{50}\) The employment range was 7-42 years with a mean of 21.3 years with a specific state DOT.
prepare them for doing long range planning, or provide the necessary skills for performing management tasks. With a weak starting point and the heavy emphasis on in-house vertical training, this may have led to educational inbreeding and therefore limited the ability to acquire better evolutionary knowledge from the “outside” for improving long range transportation planning. 51

Fifty-two percent of the respondents stated that they wished they had the time just to keep up on general transportation issues, let alone newer analytical planning methodologies. A follow up to question #10 on familiarity of long range planning processes in other professions was asked. This included whether they had ever heard of the Analytical Hierarchy Process (AHP), and then if they had heard of Arrow’s Impossibility Theorem. In both questions the responses were 100% “no.” In the case of one response on AHP one planner upon reflection thought he had just heard that week that their bridge group was implementing AHP for prioritization for repair and maintenance. This was correct and was the result of the author having spoken with that state 3 years earlier on prioritization, and subsequently introducing AHP to them as a possible useful methodology. The application however was being used only for short range decisions and utilized only engineering oriented parameters.

Arrow’s Impossibility Theorem is something that was not expected to be known by transportation planners and the responses confirmed that. The question was posed as I wanted to know if there was any awareness in the difficulty of creating social welfare

51 Although a contributing factor, the research conducted cannot directly determine if “educational inbreeding” was a specific factor for the failure of more effective long range transportation planning techniques being implemented at a state level versus other more traditional explanations of institutional rigidity, satisficing solutions, or institutional provincialism. This issue merits further investigation.
functions as related to prioritizing the public’s values and desires in a fair manner for future transportation infrastructure.

The public participation process is considered dysfunctional and ineffective by all the respondents and was brought up unprompted many times in the interview process. In particular, when queried about the usefulness of the long range planning process, all expressed the opinion that the public “doesn’t trust” or has “no faith” in the plan, or the DOT (both generally and the Planning department specifically). This perception was stated as being caused by both the failure over the long time of not being able to deliver on previous plans’ projections or promises, and the public’s views were given “lip service,” to what was perceived as DOT foregone conclusions. Planners in general felt overwhelmed in completing daily tasks and limited in their ability to do more. The majority of the comments were “I wish I could” or “I know I should.” The isolation of planners not having the time for meaningful interaction outside of transportation to gain new skills and the understanding of more effective alternative long range planning methodologies and public participation approaches underscores what the literature identifies as a major weakness of “silos” and the effects of “institutionalized ignorance” (Merkelsen, 2011).52

The linear extrapolation of historical trends within the rational planning model construct continues to be the primary analytic methodological tool in use for long range planning; even though the practitioners all agree it is ineffective and inaccurate. Defense for continuing use of the approach is twofold; the resultant plans are not utilized in

52 Institutionalized ignorance here is used in the context of the legitimacy of the Federal-State Long Range Planning Process being unchallenged with participants relying on the results of the planning process while recognizing the plans are meaningless, and essentially what Merkelsen calls a “fantasy document.”
practice, and there is insufficient available time to become knowledgeable in alternative newer approaches. Planners are in agreement, however, that the continuous intellectual process of planning is more important than a single produced plan. However, with the ineffective linear predict-then-act methodology being employed as the primary decision tool to guide policy development, discourse on policy alternatives becomes misguided as planners, engineers, stakeholders and the public become unconsciously informed with “bad insights” that erroneously frames the discussion, whether or not this is formally acknowledged.

The process becomes corrupted from the unintended consequences of distorted perceptual filters. This self-infliction of bad information insights over time may be one of the factors that has exacerbated the discord and distrust of the public, the planners’ DOT engineering counterparts, and other stakeholders, for a state’s long range transportation plan and the formal planning process, since the results were almost “always wrong.” This phenomenon is not new to social science, yet it appears not to be recognized in long range transportation planning at the federal-state practice level due to its primary engineering-centric focus.

This continuing divide between engineers, planners and the public in their inability to communicate and understand different quality of life philosophies and epistemological perspectives is another aspect of the distrust between participants. All the respondents identified this as a challenge, but did not know what corrective actions were needed to remedy the situation. As with other professions there exists a continuum of intellectual ability and knowledge needed to solve problems; significant vertical knowledge to address issues to the minutest of detail and achieve a solution that few
otherwise would know how to do (designing a 1,500 foot long cable-stayed bridge for example), or the broadest of horizontal knowledge to integrate and see solutions others can’t grasp that are missed because of the vertical reductionist perspective (how can we reduce total deaths within a State due to accidents of all kinds regardless of limiting analyses to agency organizational boundaries and responsibilities). Transportation infrastructure long range planning was born of civil engineering parents and appears to continue to be perceived and managed as a physical natural science and not a social science. Yet, the literature and interview results indicate that the issues of value, priority setting, quality of life, communications, and public participation, all fall within the confines of social and behavioral sciences’ methodologies.

A similar conclusion was reached by Pamela Lebeaux in her doctoral thesis What to Tell the Public? (2012). Although state and federal transportation planning processes require public meetings and citizen participation, the meetings still had a “project delivery” mentality, even when run by non-engineers, focusing on “what” and “where” to build infrastructure, rather than engaging the public as to “why.” This situation results in no dialog about options, collaboration, joint discovery of problems, new insights, or possible alternative solutions. Lebeaux specifically identified “value” as a missing element in the dialog. It appears the sequence of how problems are solved in the transportation field is backwards. The social science of determining public value, need and desire should precede the development of the engineering solutions, and not the reverse; yet the literature demonstrates this has been the norm since the inception of required federal requirements for transportation infrastructure planning. Urban land use
planning made this transition from geometric engineering approaches to more social science driven concepts informing physical design almost 100 years ago.

Question 12 “How would you describe the planning relationship or philosophy between long range transportation planning needs and land use in your state” resulted in 24 of 26 respondents stating there was none! Upon further discussion it was revealed that the issue was home rule versus state control and eminent domain which led to a trust and fear issue of state and federal authority versus local governance. The fear and trust issue was also identified by the two state directors who felt there was alignment between land use and transportation in their state. However, these two states represented the extreme in characteristics of the 50 states in transportation terms. The state ranked 1st in highest population density in the United States responded that land use and transportation were “very tightly aligned;” however that state only controls 6% of its transportation network and is rated in the bottom ten states in terms of highway quality. The other state is ranked 50th in population density and 80% of its land is under the Federal Bureau of Land Management, and they have no direct control or involvement in that land use. It is rated in the top ten of states for highway condition. When restricted federal land is removed from the calculation both states end up being of nearly identical size.

For the 92.3% of respondents that indicated there was no relationship between land use and transportation, 50% indicated that they were explicitly directed not to involve state transportation planning with land use planning. All respondents personally felt that dialogue and discussion was essential for the success of land use and transportation in the long run, and the continued lack of dialogue has led to “huge disconnects,” “no policy” and “loss of relevance.” As one Director noted, “A state may
have a transportation plan, but there are 2,600 local jurisdictions who do not think so.”

This isolation between a major consumer of land, and land use management is stunning. 53

Question 11 asked: compared to other planning activities how is long range planning valued in your organization? Twenty-Four responses were highly negative and the degree of negativity was quite strong: “not worth shit,” “was crap, getting better,” “total bullshit,” “worthless as shit,” “bad, getting somewhat better,” “no one values it.”

Two respondents did not know if planning was valued as they had never received any positive feedback about planning. Previous to this question, Question 8 asked if long range planning had been successful over the past few years and if an example could be given. 77% answered with an explicit “no.” The remaining 23% when asked to give an example of its success, the resulting answers were very weak in support: “Yes, well no, not really,” “somewhat, nobody knows,” “sort of,” “yes, because it points out financial doom” (said with great laughter). Asked to reflect again, none of the interviewees could give a concrete example of where the process was considered successful. Question 6 asked how the SLRTP is used as a policy resource. 26 of 26 responded that it is not used as a policy resource. Again responses were highly negative. The one exception was also negative, but indicated once per year on a singular technical issue of highway surface

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53 State and Federal transportation agencies track surface highway network size by the linear measure of lane miles (a one way 3 lane highway would equal 3 lane miles if 1 mile long). Only excess land is measured in acreage. In 2011 Delaware had 3,748 acres of excess land and 13,652 lane miles of highways. These two measures are incommensurable. Until requested by me when Director of Transportation Planning in 2011, there was no knowledge in DelDOT of how many actual acres of land were consumed by the DE highway network. The answer was found to be 95,975 acres, or approximately 7% of the entire state. An Assistant Director commented upon hearing this result that “It’s a good thing the public doesn’t know that or they would really hate us.” Lack of understanding by participants of basic terminology and the relationship of land and transportation may be one element of the difficulty in effective public involvement in transportation policy development.
quality, a singular performance measure of IRI (International Roughness Indicator) was looked at.

Question 15 asked what the time horizon of a long range plan should be and why? This was the only question that yielded a diversity of answers and a high degree of insecurity by the respondents’ confidence in their answers. The timeframes ranged from 5 to 100 years. However, when pressed for a more explicit justification, the preferred range became 5-10 years, which is not “long range” given the characteristics of transportation infrastructure life and building cycles. All of the estimate responses had various caveats of “depends on funding,” “difficult to put your head around,” “black swan events do occur,” “too long and it loses vitality.” In the discussions there was ambivalence in recognizing and accepting the difference between forecasting and planning. Given that all the respondents had no practice knowledge beyond the predict-then-act approach which focused ultimately on a “singular buildable plan” based on population and usage forecasts this ambivalence is understandable.

This same lack of knowledge was also exhibited in answering question 17 on the methodologies used to consider and evaluate the eight planning factors required by TEA-21 and SAFETEA-LU in developing a long range plan. None of the respondents had working knowledge of the methodologies that were incorporated into the analytic aspects of their plan development regardless of whether the plan was done in-house or externally by consultants. All felt there was a significant lack of economics knowledge available in their planning departments to deal with economic vitality as aspects of a long range plan, and in particular defining what it meant. Conversely, all felt comfortable with dealing
with the issue of safety. However, on deeper questioning all considered safety in a short range perspective, not in the context of long range planning. 54

Question 14 asked the implication of climate change on state-wide long range planning. Aside from one very negative response of a “Bunch of bullshit and I don’t buy into it,” all other respondents indicated it is a challenge of dimensions not fully understood by them, and planning directors are looking for help in how to plan for it. Question 9 asked of the specific singular greatest challenge they face in doing long range planning. Climate change came up second to last however with 57% citing funding, 23% lack of flexibility in federal policy, climate change/energy issues 14%, and 11% knowledge capability of their staff. The interplay of separating short term issues from long term context risks appeared difficult for the respondents. However the issue of policy flexibility, discussed in terms of “scale” repeatedly came up in the discussions with all the respondents.

The approach to the distribution of funds and the multiple programs is considered inadequate by the planning Directors to account for the great diversity in the character of states across many more variables of consequence other than just lane miles and population. Other characteristics mentioned were physical size, density, population demographics, geography, and relationship of a particular state’s physical location within the United States given larger national and international priorities. However, all respondents indicated that since there is no recognized national strategic mission, this dialog is fruitless and hard to accomplish at the current time.

54 Safety was viewed from a data driven historical perspective relating to physical construction and current situations (need for a traffic light, geometric surface changes, lighting, etc.).
6.4 Synthesis and Conclusions

The survey of State Planning Directors demonstrated that long range transportation plans done by States every five years are “put on the shelf,” not used, not referred to, and not incorporated into actual planning practice. The last five year cycle of federally mandated long range transportation planning generated over 10,000 pages of final plan documentation, yet was described as “worthless” by the practitioners that created it, disregarded by the agency engineers supposed to follow it, and distrusted by the public affected by it. The developed plans were not utilized for determining future policy options, notwithstanding federal and state policy documentation and regulation stating the contrary. The only time the plans are referred to is when it is time to do another one.

The Planning Directors interviewed were unanimous in their opinion that the federal focus was highly prescriptive with emphasis placed on having a plan per regulation rather than a focus on a recursive planning process that might be more effective. In the absence of an articulated national mission statement and objectives, the requirement of “one size fits all regulation” led to distain for federal oversight with State Planning Directors “just doing the plan to get it done as cheaply and as fast as possible.” There has been goal displacement in why a long range plan should be done. As currently practiced, a state long range plan is not a guidance document for policy development. It is a plan and process that has become a “check off” requirement to acquire federal transportation funds.

All surveyed State Transportation Planning Directors responsible for the development of SLRTPs agreed that the linear rational planning model of predict-then-
act used to create the plans was ineffective and misleading, yet 68% will continue to use it in the absence of knowing what else to do. “That’s the way we have always done it” has become the driving principle of state long range transportation plan development, disregarding the knowledge that the existing method does not work, public participation and involvement approaches are ineffective, and that the strategic outcomes desired are not fully understood, or consistent with actual operating objectives.

Although State Directors of Transportation Planning had extensive vertical experience within their respective agencies with long work tenures, they had limited knowledge of long range planning practices outside of transportation generally and multi-criterion and multi-attribute prioritization and decision science methods specifically. Undergraduate education may not have prepared them with the needed technical or management skills necessary to manage multi-faceted, multi-dimensional planning processes, or understand the analytical options available for long range transportation plan development. In house and on the job training was cited as the most significant resource of their planning knowledge. Given that the plans are ineffective, and the practitioners did not know what else to do, the situation may be the result of intellectual inbreeding, where a federal focus on regulation and prescription over planning innovation has led to mediocrity and a failure of long range planning to be an effective policy tool. Historically, in a perverse way, society may have benefited in some small fashion from the ineffective plans not being utilized and instead replaced with ongoing engineering judgments, alternative political processes, and other societal imperatives.

There were a few, although not many, examples cited by the planning directors where their State had chosen transportation actions today that would be more consistent
with the State’s long term interests and be considered as more robust, resilient, or anti-fragile actions as discussed in this research. The examples given, however, were not voiced when the direct question was asked about the success of long range planning specifically, or the resulting plans generally in their state, and if there were examples they could cite. Rather, the examples came up in an almost offhanded manner after the formal aspects of the interview process had been completed. Somehow these topics were not considered as part of the formal nature of the long range transportation planning process as perceived by the subjects interviewed. Yet, they were more important in and of themselves in potentially indentifying more novel approaches to successful long range planning.

On the subject of climate change two State Planning Directors felt they were well ahead of the nation as a whole, and the USDOT in particular. At the time of the interviews, one state had for over 20 years been making transportation infrastructure decisions that assumed a precautionary approach under the possibility of climate change. This resulted in physical decisions to locate and relocate (rather than rebuild or maintain) infrastructure farther inland then what normal “conventional practice” would have assumed and permitted along their coastline. In another State it was normal practice to design bridges against assumed 100 year flood levels. In this particular example the planning department undertook doing a more comprehensive 200+ year scenario plan to see “what if.” Specifically, a particular river flooded to the point that all bridges became inundated and impassible; isolating approximately half the population from the only

55 Federal Regulations and Rutgers University Institutional Review Board protocols for human subject research require that the confidentially of interviewed subjects be continuously maintained. A State therefore cannot be uniquely identified as to actions taken since this can be traced back to the interviewed individual as the source of that information.
major hospital in the area. This particular bridge and its approaches were elevated approximately 1 foot higher than what the 200+ year scenario indicated. Through negotiation and redesign there was virtually no increase in the cost to rebuild the bridge and its construction was completed in 2011. One year later in 2012 super storm Sandy hit and it was the only bridge in the area that was not flooded out.

In another State the planning department held a public “Hack-a-thon.” A majority of the State’s raw data on transportation was made available via the Internet for access by the general public to analyze in any fashion they saw fit. It was hoped this effort might result in insights that transportation insiders may not have contemplated or noticed. In two other states it was mentioned that a “change in perspective” had some impact on individuals’ approaches to planning. In one State rather than having the transportation plan be from the issuing agency (ie the State DOT) and reflecting USDOT requirements; it was recast to be reflective of the entire State in general and not presented as an agency specific plan. It was felt that this approach seemed to resonate better with the public and appeared to diffuse tensions and reduce the tendency for administrative “silos” at the State level. In another State DOT direct labor, middle and senior management employees were asked to participate in an interpretive dance class that had been developed by a local university. It tried to tell a story and evoke emotions by having participants pretend they were trains, vehicles, pedestrian and bicyclists and created simulated crashes, pile-ups, deaths and delays. It was indicated that the effects on the participants were dramatic, although not universal, and several of the participants indicated that it genuinely affected their thinking. The program was discontinued after two years and may have been the result of an elected official who commented on hearing of the program: “if you have the
time and money to piss it away on things like that perhaps we need to reevaluate your 
budget.” Fostering mindfulness and questioning preconceived ideas is not an easy 
process to alter.

Chapter 7 integrates the findings from the interviews, the DelDOT case study 
and the analysis of the 50 State Long Range Transportation Plans in answering the 
original four thesis questions:

a) What are current practices in transportation forecasting and planning?

b) How, if at all, have practices changed over the last five decades?

c) What factors are responsible for the current state of practice? (federal/state 
   regulation, requirements, staff training, etc).

d) What factors could change current practice? (altered federal/state 
   requirements, exogenous factors as budgets, climate change creating pressure 
   on federal and state DOTs, changes in educational practices)

Section 7.2 addresses general considerations based on the research and makes six 
explicit policy recommendations for implementation. Section 7.3 identifies several areas 
of future research that may: 1) enhance the nature of “scale” awareness and reduce the 
reliance of “one size fits all” regulation by providing alternatives to the only using 
population, VMT, road miles, and previous funding levels, to determine future 
allocations to States and thereby increasing the dynamic range of long range plans so 
they can achieve greater Antifragile characteristics and be more robust and resilient, and 
2) consideration of collaborative ethnographic techniques to improve public involvement 
and participation. Section 7.4 provides a final assessment of the research.
“We can’t get there if we don’t know where we are going.”

State Director of Transportation Planning 2012

-CHAPTER 7-

Research Summary, Policy Recommendations and Future Research

7.1 Answering the Four Thesis Questions

By the end of the 20th Century the United States was the predominant Super Power and the largest economy in the world. Given that context, can our historical surface transportation long range planning therefore be considered a failure? In the early 21st Century, participants and stakeholders in transportation planning processes agree that both individual States and the Federal Government collectively, cannot maintain the resultant transportation infrastructure that was created in the 20th Century (NSTPRSC, 2007; AASHTO, 2012; ASCE, 2013; USDOT, 2013). The system is not sustainable and cannot meet existing or future needs. Given this context the need exists for a modified planning process that is more conducive to new approaches that are capable of developing robust and adaptive planning policies, is trusted by all stakeholders, resilient to future uncertainties, and actually functions as designed.

The title of the Dissertation posed the question “should the rational planning model in long range transportation planning be replaced?” The research demonstrates that the answer is yes. For short range planning, if the transportation decision is being made where there is low uncertainty risk, certainty in means and desired ends, and driven by

56 The United States Highway Trust Fund became insolvent in 2015 for the 34th time since 2008 and required a temporary congressional approval of funds to be transferred from the federal general fund (USA Today, July 24, 2015). A 5 year funding bill was finally approved on 12/4/2015.
both qualitative and quantitative evidence, the single point estimate rational planning model of predict-then-act as used in project management applies. In long range transportation planning, where there is deep uncertainty on agreement as to conceptual models employed, key parameters are not fully understood or agreed upon, and the desirability of outcomes differs among stakeholders, all within stochastic physical and political environments, the single point estimate rational planning model should not be used.

The research validated the thesis hypothesis that “implementing improved long range transportation planning methodologies are inhibited by institutional and/or organizational structures that are not conducive to new methodological options.” However, this was not the only reason. The research identified additional reasons in answering the four thesis questions by 1) describing current practices, 2) identifying that long range transportation planning practice has changed very little over the past five decades at the federal-state strategic level, and 3) that in undetermined proportions, a combination of the following has degraded long range transportation planning:

- organizational ignorance and/or oligarchy
- inadequate staff knowledge
- failure to articulate a national mission and goals
- continuing systemic communication problems within and between planners, engineers and the public that has led to distrust in the planning process
- semantic confusion in the relationship and definition of planning versus forecasting
These circumstances have degraded the process into a funding check-off as opposed to a decision aid process for developing meaningful and robust policy as originally conceived in the 1962 enabling federal legislation. Thesis question 4, “what factors might change this situation” is described more fully in sections 7.2 and 7.3 along with recommended policy changes and future research considerations.

Isolating functional administrative and institutional boundaries, within and beyond transportation, limited the potential for more holistic planning to improve performance; even though the published mission and goal statements at the state and federal level imply a “systems view” is being employed. Systems and holistic planning is talked about, recommended and described in agency literature at the state and federal level, yet operationally segmented and disconnected at the practice level. Figure 14 depicts the USDOT-FHWA schematic showing transportation planning as a recursive, continuous and integrated process. Development of the Long Range Transportation Plan (LRP) is shown as an integral part in the center of the planning process. The research has shown this not to be true. To paraphrase Hans Christian Anderson, “The King has no clothes” with regard to the historically and currently assumed, state-federal long range transportation process of long range planning. The long range plan component and its developmental process is an isolated and disconnected element of planning. The research has demonstrated how the long range transportation planning process is actually carried out at the state practice level and is depicted in Figure 15. The “fantasy document” flow chart shown in Figure 14 continues to be represented as a reality in 2015 in the USDOT’s 30 year draft plan Beyond Traffic 2045: Trends and Choices (pg. 156).
PUBLISHED USDOT-FHWA TRANSPORTATION PLANNING PROCESS

FIGURE 15

ACTUAL USDOT-FHWA PLANNING PROCESS AS PRACTICED

ISOLATED AND DISCONNECTED SLRTP PROCESS

IS 5 years up?

NO

YES

Do new SLRTP
At the short range tactical level, various scenario and multi-criteria and multi-attribute approaches have been utilized in U.S. transportation planning. They, however, have not migrated significantly up to the strategic level, and therefore strategic policy development is still limited in its ultimate utility to yield more effective solutions. Methods of data collection, the ability to accumulate data and present data have advanced significantly. However, the research has shown that the linear extrapolation of historical trends within the rational planning model continues to be the primary analytic methodological tool in use; even though practitioners agree it is ineffective and inaccurate. With erroneous decision aids employed, discourse on policy alternatives becomes misguided as planners and the public become unconsciously informed with “bad insights,” whether or not they are formally acknowledged. The process becomes corrupted from the unintended consequences from distorted perceptual filters. This self-infliction of bad information insights over time appears to be one of the factors that has exacerbated the discord and distrust of the public for long range transportation plans and the process that develops them.

Federal surface transportation policy and regulation evolved and matured in the early 1960s with a mandate and explicit mission to build the Interstate Highway System. The mission was completed in the late 1980s. The research demonstrates that practitioners believe that in the absence of a reformulated strategic national mission, discordant objectives have created conflicting policies resulting in ineffective use of limited financial resources and not achieving desired outcomes. This appears to have led to “non-decision-making” at the federal-state level on contentious issues in long range transportation planning such as climate change, significant migration of funds across
modal options, funding approaches, and organizing administrative structures to meet future issues, rather than historical artifacts. The non-decision making would appear to echo Thomas Paine’s observations made over two hundred years ago:

“A long habit of not thinking a thing wrong, gives it a superficial appearance of being right, and raises at first a formidable outcry in defense of custom. But the tumult soon subsides. Time makes more converts than reason” (Common Sense, 1776).

Until the late 1970’s there was a general lack of knowledge on the specific functioning of the human brain in the creative process and how it determined value. Since the late 1970s there have been dramatic advances in neuroscience and positive psychology on how we can maximize the opportunity for our brain to be creative and overcome many, if not all, the bounds of our rationality. It can be posited therefore that the continued use of outdated and ineffective long range transportation planning approaches may be the result of a cycle of institutional “habit,” given the brain’s proclivity to maximize its own energy efficiency by shifting repeated actions to rote execution and away from the brain’s higher energy consumptive activities of creative thinking (Duhigg, 2012). If this is the case, one might expect nothing to change across a majority of professional disciplines unless there was a “break” in the habit caused by a forcing function either by design or accident. Rather than wait for dangerous exogenous events such as accidents or disasters to force consideration of change, it is reasonable to assume that more creative approaches might be employed that enhance the human ability to generate more effective policies and processes before the fact; foresight being preferred to hindsight. Whether the casual function was habit or oligarchy the outcome is the same; resistance to change and its associated uncertainty leading to policy
degradation over time impacted by constantly evolving endogenous and exogenous stressors.57

John Miller argues that, “A narrow range of professional expertise dominates an individual organization preventing the organizational learning needed in times of change and can be a major source of rigidity” (Miller, 2003). The limitation of habit prevents creation of more effective policies and the effect is further amplified by Fundamental Attribution Error; where planners and engineers tend to ignore situational forces that shape people’s behavior (Heath, 2010).58 These two contributory factors may help explain the inability of long range planning transportation practitioners to overcome the barriers to creating better public engagement and participatory approaches; while still recognizing these approaches do not work as intended, yet continuing to use them.

The rigid planning processes and organizational structures of the federal-state transportation architecture have not been conducive to the generation of new ideas or policy concepts where their very creation may undermine or eliminate organizations that created them (Lehrer, 2012). As opposed to the market forces of “creative destruction” posited by Joseph Schumpeter as necessary for continued success and innovation, federal-state long range transportation planning may be in what he described as the “perennial lull” due to the lack of equivalent free competition to incent better

57 Robert Michels postulated in 1911 the iron law of oligarchy: people at the top of an organization increase their power, and those at the bottom become more interested in maintaining power than in the interests of the organization (Michels 1968 ed.).
58 Fundamental Attribution Error (FAR) is a person’s tendency to place an undue emphasis on internal characteristics to explain someone else's behavior in a given situation, rather than considering other external factors, that is cognitive bias (adapted from http://en.wikipedia.org/wiki/Fundamental_attribution_error, accessed 04-06-15)
performance. There has been little “free space” within the federal-state long range planning paradigm since the early 1960s. Without free space, a rigid organizational and operational environment limits the potential for innovation. Barriers to successful innovation are predominately psychological and political in nature, yet transportation planners at the federal and state level continue to try to solve them with structured rational planning models driven by engineering principles.

States are moving toward Vision based Long Range Transportation Plans because they are cheaper and easier to produce, not because they are more effective than alternative approaches. The consensus by planning directors is that reduced political risk is more easily achieved by having a Vision based plan. It is harder to refute a Vision based plan and reduces the perception of having failed since no specific infrastructure commitments are made. This meets federal requirements for a long range plan and assures continuing funding qualification, yet yields no increase in the practical wisdom needed to produce better policy outcomes given an uncertain future.

The research indicated that undergraduate education (for both engineering and non-engineering disciplines) did little to prepare planners for either managing or doing long range transportation planning. This issue rests in the philosophical arena as to the purpose of an undergraduate college education: a career and job focus or a liberal education to permit you to be a critical thinker, or some combination of both. The predominance of practitioner knowledge came from on the job and in-house training and

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59 Joseph Schumpeter in 1943 stated in Capitalism, Socialism and Democracy that “Every piece of business strategy acquires its true significance only against the background of that process and within the situation created by it. It must be seen in its role in the perennial gale of creative destruction; it cannot be understood irrespective of it or, in fact, on the hypothesis that there is a perennial lull” (Schumpeter, (1976 edition, pp. 83-84).

60 The Free Space concept is where potential innovation is not constrained by a dominant group’s or organization’s perspective (Heath, 2010).
This long term mono-culture evolution appears to have led to a distorted view of the “outside world” and reduced the proclivity to seek new knowledge leading to a preference to stick with the status quo, although desiring to do otherwise. Within the transportation planning organizational structures at both the federal and state level the primary motivational force appeared to be avoidance of embarrassment and career risk.

A missing element in most planning participants’ knowledge and experience appeared to be the awareness of newer social psychology based approaches that assist humans to overcome cognitive limitations and permit a student or practitioner to go beyond unconscious limiting bounded rationalities. If this is the case, using techniques such as *mindfulness* is one way to overcome habit (Langer, 1997). Mindfulness is the process of looking consciously for what is new and different and questioning preconceived ideas, as opposed to mindless actions (Langer, 2010). Mindfulness can foster greater innovation and insight by all participants in the planning process leading to greater insights and the potential for more robust and flexible transportation policy development. Figure 16 depicts the differences between classical subject knowledge and intelligence in linear decision making versus the mindfulness approach.

In the DelDOT case study, the implementation of AHP suggests that the historical circle of irrelevance and failure of SLRTPs *might* have evolved differently had a greater number of states incorporated more superior policy planning methodologies decades earlier that were available for use at that time. AHP provided exposure to insights that previously were not perceived. Although not completely mindful in approach, changing perspectives brought about by the results of the AHP application, required “stepping back from historically defined problems and perceived solutions,” an element of the
mindfulness approach. In doing so, the long range transportation plans might have become more salient by virtue of more successful application over time since “conformity and boredom subjugates creativity and self-inflicted harmful habits arise in its place” (Mazzucco, 2011).

-Figure 16-

**Classical Problem Solving versus a Mindfulness Perspective**

<table>
<thead>
<tr>
<th>Classical Perspectives</th>
<th>Mindfulness Perspectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifies optimal fit between individual and environment for defined corresponding reality.</td>
<td>Identifies many possible perspectives from which a situation may be viewed.</td>
</tr>
<tr>
<td>Linear process moving from problem definition to resolution as quickly as possible.</td>
<td>Steps back from both perceived problems and perceived solutions to view situations as novel.</td>
</tr>
<tr>
<td>A means of achieving a desired outcome.</td>
<td>A process through which meaning is given to outcomes.</td>
</tr>
<tr>
<td>Developed from an observing expert’s perspective which focuses on stable categories (silos).</td>
<td>Developed from an actor’s ability to experience personal control by shifting perspectives</td>
</tr>
<tr>
<td>Solutions depend on remembered facts and learned skills in contexts that are <em>sometimes</em> perceived as novel.</td>
<td>Accepts the fluidity of knowledge and skills and recognizes advantages and disadvantages in each and assumes both are novel.</td>
</tr>
</tbody>
</table>

Problem Solving Flow
(Adapted and modified from Table 1, page 110 *The Power of Mindful Thinking*. Ellen Langer 1997.Cambridge, MA. Da Capo Press.)

If planners had more exposure “outside” of their industry and agency, they *might* have been able to infuse new acquired knowledge in planning in an incremental
bottom up strategy. Alternatively, in a top down strategy, federal transportation agencies could have evolved faster structurally, as the literature review indicates did occur in some professional disciplines in response to changing exogenous environments. Neither circumstance appears to have occurred in the federal-state transportation long range planning paradigm.

The lack of “scale” in federal policy and regulation leading to distorted funding and regulation requirements was a significant theme expressed by all respondents in the interviews. 61 Since the beginning of federal matching funds, allocations to states have been based on population, VMT, and a mileage formula with a minority of the allocations reflecting guaranteed minimums where states contribute less to the federal government than what they receive. In the 30 years since completion of the Interstate system, financial distributions have continued to be based on these politically negotiated unproven assumptions that the chosen variables were correlated to desired outcomes for yet to be articulated strategic national interests. Federal funding categories were allocated across 108 individual programs until the MAP-21 was signed into law in 2012. MAP-21 reduced the program number to 30, yet kept the same requirements for funding and organizational administrative constructs from the original 108 programs, effectively constraining change. This administrative structure continues unchanged with the FAST ACT (Fixing American’s Surface Transportation) signed into law on December 4, 2015.

In 1962 when the Federal-Aid Highway act was passed that established the current prescriptive regulatory framework for long range transportation planning, the

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61 All practitioners in the survey questioned USDOT policies and requirements which did not account for the differences in states for any particular scale of system or state measurement parameter that becomes ineffective when applied beyond the hypothetical mean and involves extremes (i.e. significantly larger or smaller outliers).
U.S. had a population of 186.5 million people, a positive balance of trade of $3.370 billion, climate change was not yet a determinant of transportation policy, federal funding for transportation was more readily available, and state transportation planning was an internally focused, self-determinant civil engineering project process of building capacity to meet forecasted demand. In 2015 the U.S. had a population of 320.7 million people, a negative trade balance of $540.362 billion, the federal trust fund was bankrupt, climate change had become a contentious consideration accelerating in credibility, all states lacked finances sufficient to maintain their existing transportation infrastructure, and the planning environment of transportation has been redefined by external global political economic change; yet the same ineffective long range planning methodology from 1962 continued to be used.\(^{62}\) The transportation planning environment has changed. Regardless of the ambiguity as to the originator of the quote “Insanity is doing the same thing over and over and expecting different results,” it would seem appropriate to apply it to the federal-state long range transportation planning paradigm of the last fifty years.

My original assumptions for researching the federal-state long range transportation planning paradigm assumed that the problematic issues were analytical in nature. The final results of the research have demonstrated the subject to be far more interconnected with social and behavior science issues of power, organization, habit, value, and trust. In that context, although weak analytical methods may have been used at the practice level, without dealing first with the aforementioned issues, implementing alternative, although improved analytical tools, might be of little effect. As stated by Mierzejewski “The long range transportation planning process generates complex

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answers to the wrong questions” (Mierzejewski, 1995). Long range transportation planning has been shown to have greater social/behavioral science aspects to it, rather than just physical science civil engineering principles, and therefore needs to develop more appropriate broader questions in order to achieve meaning insights.

My fourth thesis question asked what factors could change current practice? It is distressing to note that given the gravity of the problems identified in federal-state long range planning that policy and practice has been slow to respond to the need for change to remain relevant. The Analytical Hierarchy Process, a policy planning and valuing methodology “new” to the long range transportation planning community, and implemented in the DelDOT case study, demonstrated its value in providing planners with information yielding 1) previously hidden insights for improvements in desired policy outcomes, 2) the ability to have a structured comparison of criterion and stakeholder values across policy options for collective evolutionary learning over time, and 3) generating policy options that achieved greater financial efficiency as described by the DelDOT Planning Director as “more bang for the buck.” The use of AHP may be a very salient methodology to bring together the public and planning agencies that provides an understandable and structured means for presenting the interwoven aspects of desire, value, and priority given financial constraints for yielding greater consensus given an uncertain future and the enormity in the nature of the number of options.63

However, should the first step to change be a bottom up strategy from states to effect federal policy change, or should the focus be on a top down approach? In the absence of a Nietzsche Ubermensch creating an instantaneous and accepted new

63 In the DelDOT case study the number of possible infrastructure projects under consideration and evaluation was over 800 and Delaware is a small State.
perspective on long range planning at the federal level, current transportation planning will continue to be an uphill challenge for states in the absence of an articulated national mission and associated goals.\textsuperscript{64}

The research identified several methods utilized in other professional disciplines that can be applied to long range transportation planning and may yield more robust and flexible “Antifragile” policies that remain applicable under broad stochastic conditions and by definition are more resilient and sustainable. Long Range Policy Analysis (LRPA) and AHP can be applied concurrently for helping create better insights for developing transportation policies. Integrating these new continuous, recursive long range non-point specific sustainability and resiliency approaches into the actual operational functionality of the current mandated TIP-STIP process may not be possible at the current time without changes in the 50 year old federal legislative requirements. Without changes in legislated process as it currently exists, the SLRTP may remain a decoupled footnote reference. Simple awareness of better planning techniques and public participation approaches may provide the first steps to bring about evolutionary improvement, if not revolutionary change. Exogenous factors such as climate change may continue to provide the shocks that drive revolutionary policy change over regulatory inertia in the need for self-preservation as a society.


“Even though we navigate daily through a perceptual world of three spatial dimensions and reason occasionally about higher dimensional arenas with mathematical ease, the world portrayed on our information

\textsuperscript{64} Philosopher Friedrich Nietzsche’s \textit{Ubermensch} was a superior man who would not be the product of long evolution. He would emerge with a superior potential and strike off conventional “herd morality.” Nietzsche envisioned a “Caesar with Christ’s soul.”

In the early 21st century new levels of meta-information in visual forms have transcended the limitations of transportation planning’s flat data and the uncertainty created by linguistic vagueness (Colyvan, 2008). The often quoted magical number seven plus or minus two as the cognitive limit of the number of variables a decision maker can handle is pushed to its extreme (Miller, 1956). The ability to present data and meta-data in a rich visual form that can compress or expand time at will has become commonplace (Pfautz, 2005). A picture may, or may not, be worth a thousand words, but it may very well improve our cognitive abilities and reduce the dimensions of our bounded rationality for long range transportation planning and public engagement by considering what we do not know, in terms of what we do know. However, inadequate staff knowledge at both state and federal levels of more mindful long range planning possibilities inhibits success and the potential for change. What they do know, predominantly engineering based subject knowledge is not applicable to solving problems that require psychology and the social/behavioral sciences to better understand public engagement issues and perspectives on value beyond simple cost-effectiveness. Outdated personnel descriptions of what subject knowledge is needed by state and federal transportation planners should be reevaluated in light of future needs and not obsolete historical classifications.

Many of the identified issues that have inhibited the success of the federal-state long range transportation planning processes appear not to be engineering in nature. As Abraham Kaplan stated “I call it the law of the instrument and it may be formulated as follows: “Give a small boy a hammer and he will find that everything he encounters
needs pounding” (Kaplan, 1964). Perhaps the most significant policy recommendation to be made is to stop the ineffective “pounding” and transition long range federal-state transportation planning from a quantitative engineering “single point plan” view to a more social/behavioral science perspective that considers broad possibilities and drives policy development. United States Long Range Transportation Planning over the last 50 years has succumbed to Maslow’s Hammer: “If all you have is a hammer, then every solution looks like a nail” (Maslow, 1969). A different toolset and mindset are required at both the state and federal level for the regulation and administration of long range transportation planning to be more effective.

I discovered as Dr. Michael Greenberg did and observed in his preface to *Environmental Policy Analysis & Practice* “Now I can laugh at my naiveté, but then I was horrified at the idea that good science was not the dominant consideration. I learned that good science was necessary for good policy but did not guarantee it” (Greenberg, 2007). My research has demonstrated that long range transportation planning is still in need of good science; but possibly more oriented toward greater balance with the behavioral and social sciences, then just physical, which has been the direction over the last 90 years in transportation planning.

### 7.2 Policy Recommendations

Based on the presented research, the task to create more robust, resilient and sustainable long range transportation plans requires policies be in place that are more conducive to their very generation, and not by dint of historical constructs be inhibiting
and obstructive. At a minimum five basic concerns need to be addressed before effective policies and/or plans can be developed:

- first and foremost is recognizing that for the last 25 years what is documented and stated in federal regulation on how the current federal-state long range transportation planning process functions is not correct
- creating administrative environments and flexible regulation conductive to the generation of “insight” for developing greater Antifragile policy
- using more behavioral science based mindful approaches for transportation infrastructure policy development that overcomes obsolete assumptions of the “taken for granted” cognitive limitations of planners, engineers and the public, intrinsic to historical policy creation
- reestablishing trust between all participants in the planning process
- replacing ineffective decision planning tools designed for linear deterministic systems with those designed for complex chaotic systems that greater reflect the nature of the actual transportation systems being managed

Any policy recommendations however should not be so prescriptive that they become part of the very same problems they are intended to address. The research in general, and the DelDOT Case Study specifically, demonstrated that proven multi-criteria and multi-attribute decision making methodological approaches as employed in other disciplines, specifically the Analytical Hierarchy Process and Long Term Policy
Analysis (LTPA), have been shown to enhance the development of greater insights for more salient and resilient plans and policies as compared to previous practice.\textsuperscript{65}

State Long Range Transportation Planning has degraded into being utilized as a functional accounting requirement to receive fiscal compensation from the Federal government as opposed to a tool for providing evolutionary learning and yielding more sustainable and robust infrastructure solutions that are resilient and inherently Antifragile.

To that end six principles of action are recommended that are reflective of the concerns:

1. Identify a National transportation vision, mission, and objective(s) while allowing States’ to have an individual transportation vision, mission and objective(s) independent of the Federal process.

\textsuperscript{65} Many sectors of society beyond transportation have gone through various revolutions in the evolution of their approaches to planning and subsequently replacing many aspects of the traditional rational planning model of predict-than-act. The evolution away from rearward looking deterministic linear rational planning models has been dramatic in some circumstances, although perhaps not complete; yet it has enhanced the capacity to develop novel insights and more robust and sustainable policy options that are more resilient to unanticipated future outcomes. For example: Over 2,600 years ago Sun Tzu in the “Art of War” recognized that strategic planning was not just a check list of things to accomplish, but rather an understanding of how to respond to changing conditions. For fifty years during the cold war U.S. military strategy was certain of its objective: the containment of communism and focused on a bipolar conflict with U.S.S.R. (Khalilzad, 1995). Since the 1990’s containment and focus on a bipolar conflict has been replaced with a multi-polar, multi-front, asymmetric conflict potential and military planning has required a shift to more robust, risk and uncertainty based portfolio analyses where continued reliance on the predict-than-act rational planning model proved insufficient and ineffective (Davis, et al. 2008). The Economics discipline encountered similar limits with classical quantitative approaches to provide normative answers to complex socio-economic planning questions in the 20\textsuperscript{th} Century and has since migrated to incorporating measures beyond simple utility theory to help assist in policy development (Hicks,1939; Kahneman and Tversky, 1979). Healthcare in the United States relied on a predict-than-act approach to planning until late in the 20\textsuperscript{th} Century (Laszlo, 1996). The reductionist “art” of healthcare in the 1970’s migrated to more decision sciences based holistic care and became known as Evidence Based Medicine (EBM) by the early 1990’s (Sackett, 1996). Modern manufacturing can be traced to the industrial revolution where a reductionist perspective was utilized from the very beginning between man and machine and “one best way” was espoused by Fredrick Taylor as Scientific Management (Bertalanffy, 1969). After WWII Scientific Management moved away from “one best way” to more systems oriented statistical control (Deming, 1950), and in the late 20\textsuperscript{th} Century culminated in replacing previous reward looking linear rational planning models with more risk and uncertainty based planning techniques driven by forward looking sociological, group dynamic and psychometric parameters and architectures yielding dramatic improvements in quality and resource use. (Veech, 2005).
2. Isolate unique Federal and State tactical transportation physical infrastructure performance measures from strategic non-transportation related measurements and then evaluate on an integrated basis.

3. A change in perspective beyond transportation “silos.”

4. Enhance evolutionary learning by melding short, medium, and long range planning into a continuous recursive process.

5. Implement more structured prioritization processes, such as the Analytical Hierarchy Process (AHP), so that transportation practitioners can better assess the public’s intensity preferences and expand collaborative learning opportunities for all participants.

6. Greater utilization of Long Term Policy Analysis (LTPA) that considers multiple plausible transportation futures and very wide ranging assumptions.

The overarching philosophy of the six policy recommendations is to completely replace the current existing rigid linear predict-then-act rational planning paradigm used to create and implement both Federal and State Transportation policies; if not in administrative structure, then at least in the philosophy of practice. The alternative methodological approach entails considering multiple future scenarios instead of a few, defines assumptions over very broad ranges instead of singularities or specific probability functions, incorporates newer knowledge as it becomes available instead of discrete decision points, and evaluates policy options on the basis of resilience and flexibility.
(Antifragile characteristics) and not optimal utility, and seeks satisficing long term solutions as opposed to best short term optimal solutions.66

Identify a National transportation vision, mission, and objective(s) while allowing States’ to have an individual transportation vision, mission and objective(s) independent of the Federal process. This was a major issue raised in the survey component of the research that the USDOT lacks focus and their vision, mission, and objectives are not necessarily coterminous with a particular state. In some cases Federal policies are diametrically opposed or detrimental to a particular State; although enacted under the assumption perhaps that the Federal policy was thought to be universal in application.67 The USDOT and its forerunner agencies have had only one articulated specific statement of mission for surface transportation over the last 100 years; and that was to build the Interstate and Defense Highway system.68 What originally was a vision related to maintaining national sovereignty, with the defense objective to build a high speed network for military transport; has ultimately had far reaching impacts beyond defense on our societal patterns of behavior over the last 50 years. This internally focused 100 year old perspective (although incrementally modified) needs to be

66 Satisficing Long Term solutions as used in this context is an adaptation of Herbert Simon’s (1916-2001) use of satisficing for short term decision making limited by insufficient capacity to assimilate and digest all the information needed (bounded rationality) to determine a course to maximize action and therefore settle on “good enough.” For long term planning arrived at through mindful approaches, rejecting optimal utility with its inherent potential for instability is considered a positive attribute that creates a topology of more Antifragile solutions.

67 Federal Policy in one case viewed ferry service as a short range urban commuting alternative with funds and guidelines restricted to use in that context. The Interviewed Planning Director for the State in question stated its ferry’s service was not an urban commuter option but rather a lifeline capacity for island inhabitants essential to their very existence.

68 Begun in 1962 and completed in 1991 the system had its birth as an Army exercise in 1919, with enabling Federal legislation that did not materialize until 1956, that eventually resulted in the Highway Act of 1962 (P.L. 87-866) which continues enforce in 2016 as CFR 23 (Code of Federal Regulations) as amended. The network was based on the need for speedy response to potential invasion at our borders; a trip that took an Army convoy two months to do in 1919.
transformed into a forward looking perspective. Some suggest that the perspective should be from a supranational level since US transportation is no longer an isolated self-determinant activity that ends at its borders (MacKinnon, et al., 2008). This approach, however, is grounded on only one perspective; economics.

The objective of this dissertation policy recommendation is not to foster any one perspective over another, but rather the intellectual “mindful” exercise to seek new perspectives on where we are today and looking forward, rather than backward. States may not share equally in the benefits or the burdens of this approach to establishing a new Federal transportation vision, mission, and objectives. However, if done concurrently with States establishing their own unique statements, two overarching objectives can be achieved 1) a dialog as to aggregated benefits where the sum of the component parts may exceed the whole when created independently (and then comparing notes), and 2) moving the discussion to functional specification rather than explicit Federal prescription focused on fiscal accounting and the “color of money.”

**Isolate unique Federal and State tactical transportation physical infrastructure performance measures from strategic non-transportation related measurements and then evaluate on an integrated basis.** Since 1962 characteristics of the both Federal and State Transportation Systems have been stated in terms of safety, economic vitality, security, preservation, mobility, and environmental protection. Previously a State could have gone its own way and disregarded the objectives but would have faced the potential of all federal funding being withdrawn (which never happened in practice), or now under

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69 This exercise explicitly requires the use of mindful approaches or equivalent as described on pages 124-126 or otherwise the exercise will fall back into habit and yield no new perspectives.
the current FAST Act will face penalties for specific performance measure goals not being achieved (and as of 11/2016 yet to be determined). Performance standards with regard to transportation physical infrastructure (preservation) is well documented as to service life, and generally readily accepted and understood by practitioners. Economic vitality, security, mobility, and environmental protection, however, have no universally accepted single measures of performance. Safety which previously had a singular overarching measure for surface transportation of human deaths per million miles of vehicle travel is currently under renewed scrutiny. Safety has previously been the primary focus of both Federal and State planning programs; although the dissertation goal mapping research indicated that this was not reflected in actual tactical field implementation (Figures 7, 11 and 12).

In the DelDOT example 85% of the initiating events (root causes) leading to deaths on the surface network were shown not to be under the control of the DOT or the result of its physical infrastructure. Within the system only 15% of the events could have been reasonably mitigated by process or network redesign (Figure 8, pg. 65). The nature and percentage distribution of causality types is similar across all States.

In the case of Delaware, if the performance measure was changed to “all deaths” and not just surface transportation related deaths, the perspective dramatically changes. Non-transportation related efforts (in the DE case it would have been greater access to kidney dialysis) might have resulted in less NET deaths to Delawareans at the same or lower cost. Within transportation, be it at the Federal or State level, the tactical goal to reduce deaths can never achieve a Pareto Optimal condition since even if all allocated
transportation funds are applied to the problem only a nominal 15% reduction in deaths can be achieved.

To move agency funds in this way to reduce deaths is technically illegal under current codes and regulation. This approach would be very radical in terms of today’s agency silos even though it has greater potential to achieve more financially efficient and effective desired results. In theory allocations at the highest level of government already had their priorities pre-determined (in Delaware the Governor with approval by the Legislature) by agency (DOT and DOH: Department of Health). At the Federal level this is also true in theory of the USDOT versus all other agencies and priorities reflecting the apparent public will. Dr. Frank Popper’s observation on land use regulation is equally applicable to USDOT and State DOT prioritization setting at all levels of government:

“The right to make particular regulatory decisions shifts unpredictably over time from one level of government to another. No principle of administrative rationality, constitutional entitlement, economic efficiency, or even ideological predisposition truly determines the governmental locus of decisions. It is more often a matter of the inevitably uncertain catch-as-catch-can pluralism of democratic power politics.” (Popper, 1988 pg. 229)

Even if this posit by Popper is accepted as the “norm,” mindfulness as contemplated in this dissertation can still be applied to the problems at hand, and in the case of performance measurers can be separated as to tactical versus strategic. In the case of the USDOT and the States, limiting performance measures to actual tactical stratégic physical assets under the transportation agencies’ control, with all other strategic goals prioritized collectively between all other agencies, might lead to several benefits; greater dialog between agencies (reducing the “silo” effect), a natural proclivity for greater
multidisciplinary perspectives since non-traditional disciplines would be represented at the table (as opposed to “habit” representation), and a natural reduction in “that’s the way we have always done it” views as greater questions of “why” are posed by outsiders.

A change in perspective beyond transportation “silos.” Multi-disciplinary and Inter-disciplinary thinking is easy to conjure and difficult to implement. Combining various knowledge perspectives can yield a fuller more holistic picture of what current and future circumstances might be and in doing so yield insights that exceed any individual or organizational “silo’s” perspective. This melding of intellectual resources can be described as “recombinant knowledge,” a metaphor for bringing about novel solutions which would otherwise not exist (Konig, et al, 2011). The administration of transportation planning can benefit from having more frequent interaction between and among all levels of State and Federal government agencies, and the public, to achieve greater recombinant knowledge. However, if the five tenets of the Mindfulness perspective (page 125) are not utilized as an intrinsic part of the process, cognitive convergence will not occur and the potential for a truly collaborative holistic view will be lost (Baba, et al, 2004).

Enhance evolutionary learning by melding short, medium, and long range planning into a continuous recursive process. This is perhaps the easiest recommended principle of action to implement. The existing discrete prescriptive Federal process can continue to be used from the accounting perspective (CFR 23:450.206-336). However, the input that feeds the accounting perspective should be based on a continuous process without
distinction as to short, medium, or long term thereby permitting newer knowledge to be incorporated as it becomes available and not excluding evolutionary learning opportunities on procedural grounds or existing calendar based boundary conditions.

**Implement more structured prioritization processes, such as the Analytical Hierarchy Process (AHP), so that transportation practitioners can better assess the public’s intensity preferences and expand evolutionary learning opportunities for all participants.** AHP historically has been infrequently applied within transportation long range planning. It is, however, the only Multiple-Criteria and Multi-Attribute decision and prioritization methodology that incorporates strength of preference with pair-wise comparisons of criterion of interest that can be evaluated in the context of social choice theory.\(^7^0\) This aspect of AHP is particularly compelling for establishing collaborative involvement with all segments in the planning process, especially the public. AHP creates a hierarchical structure that yields solutions that best suit the needs and goals of all actors based on their understanding of the problem rather than prescribing a “correct” decision. It can be applied to a single project, or entire State’s multi-modal transportation program. AHP facilitates collaboration where “the wisdom of crowds comes not from consensus decision making of the group, but rather the aggregation of ideas/thoughts/decisions of each individual in the group” (Surowiecki, 2005). The AHP method provides another avenue for development of insight based on new perspectives and enhances the potential for greater Antifragile policy generation.

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\(^7^0\) Social choice theory is the study of collective or collaborative decision making processes and procedures. It provides a theoretical framework(s) of analysis for combining individual opinions, preferences, interests, or welfares, to reach a singular collective decision for a stated goal.
Greater utilization of Long Term Policy Analysis (LTPA) that considers multiple plausible transportation futures and very wide ranging assumptions. The FAST ACT of 2015 recommends the use of “limited scenario analysis.” It is not clear in the legislation what the intent of the limited scenario planning is beyond the comparison of modal options and/or planning horizon timeframes. Rather than limited scenario planning my recommendation is the implementation of massive scenario planning that considers multiple plausible future holistic contexts that take into account deep uncertainty in order to yield more Antifragile transportation policies. The necessary computational power coupled with the data sets available within the Transportation industry, and those available outside of transportation’s silos, is able to perform these types of analyses. Transportation Policy that is Antifragile, robust, resilient and sustainable, creating a topology of solutions that are part of a non dominated set is achievable with current technology, except as limited by continuing administrative inertia and bounded rationality. However, it has been demonstrated in the research that these hurdles can be overcome by employing more Mindful approaches.

7.3 Future Research

My research identified several aspects of the federal-state long range transportation planning process that are in need of change, both in practice and policy, to become more effective in meeting future challenges. Tools and administrative designs are needed that foster insight, enhance trust among participants, and are capable of developing robust, resilient and sustainable policies that are naturally “Antifragile” in their inherent design.
The Transportation Research Board (TRB) in 2015 identified seven characteristics that a DOT and its staff should possess in the 21st Century (NCHRP-report 798)71:

1. Multimodal
2. Multidisciplinary
3. Creative
4. Consensus Oriented
5. Technologically Savvy
6. Skilled in data collection
7. Skilled in communication

These same skills reflected what transportation planners needed to be capable of in the 20th Century and were espoused in the literature during the previous 50 years (DeGreene, 1970). It is axiomatic, and the presented research substantiated as well, that the results of these skill sets being applied in the 21st Century will still be insufficient where the planning required is for the same single buildable plan objective based on a point estimate (CFR23:450.206), and with the same institutional structures in place that are still not conducive to new methodological options. Why should one expect the outcomes to be any different in the 21st Century then what the same recommended practices produced in the previous century? Dr. Ellen Langer would describe the continued use of these unchallenged assumptions as being typical of “mindless action” (Langer, 1997). Albert Einstein is quoted as saying “Without changing our patterns of thought, we will not be able to solve the problems that we created with our current patterns of thought.” Changing patterns of thought is a current challenge within transportation planning.

71 The National Academy of Sciences (NAS) is a private, non-profit society of distinguished scholars. Established by an Act of Congress in 1863, the NAS is charged with providing independent, objective advice to the nation on matters related to science and technology. The TRB is one of the Academies.
The TRB identified that the transportation practitioner’s tool box of the 21st Century requires more than just physical science skills. A simple statement, however, of “be creative” or “consensus oriented” is completely insufficient. How is a planner to achieve this state of creativity and consensus? There has been significant research in the last 20 years on creativity, innovation, and change, (Ariely, 2010; Carroll, 2007; Gardner, 2008; Heath, 2010; Kahneman, 2011; Lehrer, 2009, 2012; Roth, 2004; Langer 1989, 1997, 2005). My research did not yield any substantial application of the “science of creativity” within the transportation planning arena that was not otherwise focused primarily on physical technological innovations, of which there were many.  

Further research needs to be carried out to identify ways to “crack” the continuing resistance to change (regardless of what the change entails) within transportation planning. It appears the needed skills are more in the realm of the social, behavior and psychological sciences, than that of physical science. I believe that this represents a significant opportunity for further research specifically in the area of collaborative public engagement within the transportation planning process.

Dissemination of research is intended to help practitioners become more proficient and effective in performing their tasks; as Deming stated “to understand profound knowledge and improve commerce, prosperity and peace.” Distribution of my research study to all of the participants in the survey is probably insufficient to make any measurable impact on inducing needed change in long range transportation planning given the existing paradigm of practice and the attendant procedural and organizational constraints. It too would become just another “report on the shelf.”

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72 As noted on pages 111-114 there were a few examples of what might be called “flourishes of insight” that were provided by the Planning Directors. They were however rare in occurrence.

73 Deming, op. cit.
The need exists to enhance the innovative potential of current and future transportation practitioners to solve messy problems by providing them with better cognitive tools that help overcome the negative characteristic of habit and lead to greater collaborative insights. Coupled with this is the need to generate greater awareness through training, or though integration within existing planning and methods courses, the specific methodology of the Analytical Hierarchy Process (AHP). The research indicated that this tool might provide an analytic approach to help bridge the communications gap between planners, engineers and the public. By developing a measurable and structured dialog on values beyond cost effectiveness for infrastructure, it may help improve the trust factor and openness to greater collaboration. It is not known what the actual dispersion of this approach is within existing methods curricula at the undergraduate or graduate level. Although virtually non-existent within the transportation discipline at the strategic level, given its greater awareness in other disciplines this may be a transportation industry specific problem. Research on the subject would clarify the problem and provide direction.

Current transportation funding mechanisms are based on unproven assumptions that relate only to the measurement parameters of population, VMT, road mileage and previous funding allocations. There are a multitude of scale differences between states for any particular measurement parameter of interest. Some of the parameters and the ratio or scale of differences are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Scale of Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>68 to 1</td>
</tr>
<tr>
<td>VMT</td>
<td>90 to 1</td>
</tr>
<tr>
<td>Funding</td>
<td>30 to 1</td>
</tr>
<tr>
<td>Mileage</td>
<td>Rural: 552 to 1</td>
</tr>
<tr>
<td></td>
<td>Urban: 89 to 1</td>
</tr>
<tr>
<td>Land area</td>
<td>433 to 1</td>
</tr>
</tbody>
</table>
Density: 995 to 1
Ferry Distances: 2000 to 1
Water area: 601 to 1
Elevation: 21,000 to 1

Social science parameters may also be considered such as health indicators, poverty levels and education attainment, etc. None of these social parameters are in the current federal-state long range planning paradigm except as an after-the-fact consideration for development of specific infrastructure plans. Research is needed to determine what parameters might better characterize the basis for distribution of federal funds to better achieve the desired goals; assuming that mission statements and goals are defined.

Practitioners describe the current federal transportation policy approach as “one size fits all,” that in reality is “one size fits none.” Research is needed to evaluate and determine the dynamic range or elasticity of existing policy parameters and possible replacements, in their ability to remain relevant and effective over the various scales across all states. 74

My Master’s Thesis advisor recommended to me in jest many years ago that it was safer professionally to go into long range forecasting rather than short range, since that way “you won’t be around when you are proven wrong.” This attitude may still be at the crux of current long range transportation planning problems where forecasting is confused with planning, and the failure of forecasts to materialize causes disregard for the value of the planning process itself as “the plans are always wrong,” further decreasing the relevance and salience of long range planning. Perhaps something as simple as assuring that the differences between forecasting and planning are more fully articulated

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74 Dynamic range is the ability of a system to faithfully produce an output as a function of the input, regardless of scale or magnitude. This is similar to Taleb’s description of a robust narrative where changes in environment do not lead to different outcomes with an existing policy (Taleb, 2012, pg.432).
by the educational community to transportation practitioners may help in solving this issue.

7.4 Conclusion

The current regulatory paradigm of federal-state long range transportation planning has evolved over a fifty year period to be mostly incapable of addressing the practice level needs of planners to develop functional and useful long range plans for public benefit. The Federal Aid Highway Act of 1962 called for continuing, cooperative and comprehensive transportation planning. Instead, federal-state long range planning regulation and execution has undergone goal displacement and proven to be disconnected and episodic rather than continuous, uncooperative rather than inclusive, and voluminous rather than comprehensive; becoming a check-off requirement for funding and fiscal accounting rather than a meaningful collaborative process for robust transportation policy development.

Generations of forecasters have shown that the future cannot be known with any degree of determinism (Walter, 1992). Since the 1880’s it has been known that complex systems can be chaotic and prediction of a singular future outcome in that environment is impossible (Colson, 2014). Transportation is a complex and chaotic techno-human system-of-systems that is in a constant state of evolution. Even today no amount of data and computer power can predict a specific singular outcome for this complex chaotic system and overcome the phenomenon of sensitive dependency on initial conditions (Lorenz, 1963). Yet federal code continues to require single-point deterministic future predictions.

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75 Sensitive dependency on initial conditions (SDIC) shows that extremely minute initial uncertainties can have wildly dramatic impacts on future outcomes and makes prediction of a specific singular event impossible for a complex chaotic system. Edward Lorenz discovered this phenomenon by accident in 1963 while researching weather forecasting.
estimates and *singular* buildable state transportation plans for this complex chaotic system. Process has taken precedence over reality and set the stage for ongoing failure of the long range planning process.

As postulated by Thomas Kuhn in *The Structure of Scientific Revolutions*:

“A paradigm can, for that matter, even insulate the community from those socially important problems that are not reducible to the puzzle form, because they cannot be stated in the terms of the conceptual and instrumental tools the paradigm supplies” (Kuhn, 1962, pg. 37).

If long range planning within transportation is to recover its ability to create meaningful Antifragile polices that ultimately translate into physical infrastructure it must better understand justice, be it environmental or social, the concept of right versus the good (with value determined beyond cost benefit), and the incorporation of perspectives that exceed the capability of current institutionalized tools and methods. The interviews of the Transportation Planning Directors did result in some examples of “gems of wisdom“ or “flourishes of insight“ being offered. However, they were far and few between, with the individuals sounding hesitant to share them, since the perspectives taken were counter to the “conceptual and instrumental tools the paradigm supplied.”

In the words of Noble Laureate Amartya Sen “The remedy for bad reasoning is better reasoning” (Sen, 2009). It is time for a paradigm shift and better reasoning in the administration, regulation, and function of federal-state long range transportation planning beyond “that’s the way we have always done it”.

I have had the privilege to be involved with a variety of disciplines in my career in private, public and non-profit sectors domestically and internationally, including: fire fighting, electric power generation, higher education, manufacturing, military systems,
advanced technology, medicine and healthcare, and of course transportation planning. In each venue there was one shared common element; the pervasive perception that the challenges faced by the particular institution or organization were unique onto itself and "outsiders," anyone outside of that sector, could not possibly comprehend or appreciate the nature and magnitude of the problems being addressed. Only when faced with financial ruin, overwhelming manmade or natural disaster, was there a willingness born out of desperation to stop applying TTWHADI—*that’s the way we have always done it* or conventional wisdom, and seek alternative approaches. For reasons that I still do not fully comprehend myself due to my own bounded rationality, be it nature or nurture, I have always taken a multidisciplinary-multisensory approach to these challenges. In no case were the results ever less than if TTWHADI had continued to be followed, and frequently new insights were discovered along the way. Transportation Infrastructure Planning has proven itself to be no different.
Appendix A

INTERVIEW QUESTIONS

Part 1: Process and Organizational Considerations

1. Who develops your State-wide Long Rang Transportation Plan (LRTP)? What is the balance of in-house staff and consultants? What led to this selection?

2. How does organizational structure affect how a state-wide long-range plan is produced?

3. What do you consider key educational and professional skills for personnel developing state-wide long-range plans?

4. Is your long-range transportation planning continuous or episodic in nature?

5. How do federal requirements influence your statewide long-range transportation planning process and organization?

6. How is your Statewide Long-Range Transportation Plan used as a policy resource? Is it referred to as often as other planning resources such as the TIPS and STIPS?

Part 2: Planning Perceptions

7. What do you see as the primary contribution of long range transportation planning in your state?

8. Has statewide long-range transportation planning been successful over the past few decades in achieving state objectives? Can you give me examples?

9. What issues do you see affecting the success of future state-wide long-range transportation planning? What do you consider the highest risk and the greatest uncertainty?

10. Are you familiar with the long-range planning processes in another profession (such as power, aerospace, defense, etc)? If yes, are there salient differences in methodology or organization that might be of value to state-wide long-range transportation planning?

11. Compared to other planning activities how is long-range planning valued within your organization?
12. How would you describe the planning relationship or philosophy between long-range transportation needs and land use in your state?

**Part 3: Methodology Considerations**

13. Linear extrapolation of historical trends to predict future needs has long been utilized for developing state-wide long range transportation plans. Is this what you do? If not, what do you do? Has it been successful? Can it be considered an effective method for future long-range infrastructure planning?

14. Climate change has become a major international political and social issue effecting policy decisions for virtually all aspects of life. What are the implications of climate change on state-wide long-range transportation planning?

15. How long do you think the planning horizon should be for a long-range plan? Why?

16. Statewide long-range transportation plans can generally be categorized into one of five planning philosophies: Needs, Vision, Policy, Project, or Corridor. Your state uses a “XXX” based approach (XXX to be provided by me from a federal classification reference). Why was this particular method chosen over the others?

17. SAFETEA-LU and TEA-21 requires state-wide long-range plans to consider 8 planning factors (I will state these in the interview). Have your planning tools and methods been equally successful in informing future policy decisions for each factor? Are there any specific major strengths or weaknesses?

a) Economic Vitality  
b) Safety  
c) Security  
d) Accessibility/Mobility  
e) Environment  
f) Integration/Connectivity  
g) Management/Operation  
h) Preservation

**Part 4: Demographic/Psychographic Information**

18. How many years have you been involved in transportation?

19. How long have you been with your current organization?

20. What is your educational background? How did you find the experience prepared you for working in state-wide long-range transportation infrastructure planning?
21. How would you characterize your professional status (planner, engineer, sociologist, etc)? How do you think this affects your perspective on planning?

22. In transportation terms how would you describe the area where you grew up? Do you think this influenced your philosophy on planning?

23. What is your current primary commute distance and modal choice?

24. What is your age?

25. Sex (known from participant survey list, will not be asked).
Appendix B

Interview Invitation Script
Introduction and Recruitment Letter

Dear ________________,

My name is Michael Strange and I am a doctoral candidate studying planning and public policy at Rutgers University. I am contacting you in conjunction with my doctoral thesis research on long-range transportation planning. The goal of the research is to better understand the impact organizational, procedural and methodological factors have on migrating improved planning methodologies from theory into practice at the state level. States have taken a variety of approaches to long-range transportation planning and there have been numerous studies on what we do and how we do it. However, there has been virtually no research on why we select and use specific methodologies and the relationship to future policy quality. I hope that by researching this topic it will yield a greater understanding of what alternative approaches may be employed in long-range planning to generate more effective transportation policy outcomes and identify the barriers to implementation.

I have created a phone survey designed to gather data about planner perspectives on organizational, structural and methodological considerations. I am contacting state planners who are specifically responsible for long-range transportation planning. The results of the study’s findings will be shared with all participants when complete. I would like you to participate in the survey. Please let me know if you would like to participate by responding directly to this email, or by calling me at (609) 519-8372. I am available to do the interview at whatever time is most convenient for you. Should you elect to participate I will email to you Rutgers University informed consent reference information for your review prior to the phone survey. I look forward to your participation and hope the results of the research prove beneficial for the long-range transportation planning community.

Sincerely,
Michael Strange
Bloustein School of Planning and Public Policy
Rutgers, The State University of New Jersey
You are invited to participate in a research study focused on long-range transportation planning. You were selected as a participant because you are involved with state-wide long-range transportation planning. We ask that you read this form and ask any questions you may have before agreeing to be in the study. This study is being conducted by Michael Strange, a PhD candidate in Planning and Public Policy at Rutgers University. You will be asked to provide verbal consent prior to the beginning of the phone survey.

Background Information
The purpose of this study is to identify current state-wide long-range transportation planning practices and how those practices have changed over time, what factors were responsible for the current state of practice, what factors might bring about improved policy outcomes from long-range planning, and what are the barriers to effective change.

Procedures: Seventy-five to one hundred independent transportation planners, state long-range transportation planners and MPO planners will be interviewed for this study. If you agree to be in this study, we would ask you to do the following things: engage in a 45-60 minute telephone interview focused on your state’s approach to long-range planning, the nature of long-range planning problems within your state, and your perceptions on how organizational, structural and methodological factors affect the planning process. To respond to any follow-up contact, in the form of emails and/or telephone calls that may be needed to clarify survey responses. Follow-up will occur within two weeks of the initial interview. In total, including interview and follow-up time, involvement in this research project should require no more than 1½ hours of your time.

Risks and Benefits of being in the Study
There are no foreseeable risks to participation in this study. You have been told that the benefits of taking part in this study may be improved transportation planning processes and methodology that make more effective use of limited human and financial resources. Policies based on these improved approaches may yield more resilient solutions to uncertain futures and enhance the quality of life. However, you may receive no direct benefit from taking part in this study. The final product of this research will be made available to you free of charge.

Compensation: No monetary compensation will be offered to participants.

Confidentiality: This research is confidential. Confidential means that the research records will include some information about you, such as your name, age and sex; in addition, this information will be stored in such a manner that some linkage between your
identity and the response in the research exists. There exists a documented linkage between a subject's identity and his/her response in the research, and the investigator provides assurance in the protocol and in the informed consent form that the identity of any individual subject will not be revealed in any report of the study. Please note that we will keep this information confidential by limiting individual’s access to the research data and keeping it in a secure location. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated, unless you have agreed otherwise. To ensure that your confidentiality is maintained, a numeric code will be created to link the information you provide with your identity. A master list of codes and corresponding identities will be stored in a password protected file. Electronic copies of files will be stored on an encrypted and password protected system and paper copies in a locked file cabinet. Three years after the study’s completion, records of conversations and any other data you may provide will be erased (if in electronic format) or shredded (if on paper) to ensure that your confidentiality is maintained indefinitely.

**Voluntary Nature of the Study:** Participation in this study is voluntary. Should you decide not to participate, you will incur no penalties or suffer a loss of benefits to which you are otherwise entitled. Similarly, you are free to terminate your participation once started for any reason, by simply indicating this decision via phone or email.

**Contacts and Questions:** The researcher conducting this study is: Michael Strange. You may ask any questions you have. If you have questions later, you are encouraged to contact Michael Strange at: (609)-519-8372 or email at mistrang@eden.rutgers.edu or by mail at Michael Strange, 4 Stockley Street, Rehoboth Beach, DE 19971.

This research is being conducted for the purpose of a doctoral dissertation. If you have any questions you wish to ask the advisor of this project, please feel free to contact Professor Michael Greenberg at 732-932-4101 ext 673 or email at mrg@rci.rutgers.edu or by mail at Dr. Michael Greenberg, Rutgers University, Bloustein School of Planning and Public Policy, 33 Livingston Avenue, New Brunswick, NJ 08901.

If you have any questions about your rights as a research subject, you may contact the IRB Administrator at Rutgers University at: Rutgers University Institutional Review Board for the Protection of Human Subjects, Office of Research and Sponsored Programs, 3 Rutgers Plaza, New Brunswick, NJ 08901-8559 or by phone at (732) 932-0150 Ext. 2104, or email at humansubjects@orsp.rutgers.edu.
APPENDIX D

ANALYTICAL HIERARCHY PROCESS

The analytical hierarchy process was the subject of Thomas Saaty’s Doctoral Thesis. Since the 1970s it has become a widely used methodology for structuring and analyzing complex decisions. It involves a combination of matrix mathematics and aspects of psychology. Dr Saaty used a scale of -9 to +9 to gauge the strength of feeling for an individual’s particular preference of one object compared to another (ie apples preferred over oranges, and vise-versa). In a conversation with the author in 2009 he explained that he selected +9 to –9 so it was a bit greater than the assumed 7 levels of difference considered the limit of human cognition at the time. The key was establishing the decision maker’s perspective in forced pair-wise comparisons. This helped organize strength of feelings and deal with situations of “first among equals.”

A problem at hand is structured as a hierarchy with a goal, a number of evaluative criteria, and a selection of possible alternatives to achieve the goal. There is no singular correct answer in using the AHP process. As opposed to the traditional rational planning process which results in a singular correct answer, AHP yields an answer which is characterized as best by the criteria of most interest to the decision maker, regardless of the character, quality, or type of the evaluative criteria. The model can be flexed over a range of valuations to test robustness. With its hierarchical structure it provides an organized basis upon which one can reflect on the implications of the strength of beliefs, various criterion, alternative options and the magnitude of effects on results, both desired
and undesired. AHP can be utilized in a continuous and recursive way to continually incorporate new knowledge as it becomes available into the planning process.

Mathematically a hierarchy of matrices is created and eigenvectors are calculated, the resultant eigenvalues reflect the weightings of the pair wise comparisons and the evaluative criteria.\(^{76}\) It is not necessary for a user to be a math wizard in matrix algebra to use AHP. There are commercially and freely available software products which make the process easy to utilize and have a step-wise procedure to structure your problem, create evaluative criteria and develop alternatives.\(^ {77}\) A sample decision matrix layout is shown on page 144. In a group decision making environment, using appropriate AHP software, all participants via input devices in real time, can express their preferences to see the results of collective and individual perspectives shaping a desired outcome. In the DelDOT example discussed in Chapter 4 Section 4.6, preference values and criterion were developed by senior management staff to gain internal consensus and buy-in. (Although not done in the subsequent DelDOT AHP model runs, the long term view is to allow the public to participate on an ongoing basis, to create an inclusive participatory approach. As of August 2016 this participation has not yet been accomplished by DelDOT).

\(^{76}\) For more information on how eigenvectors are calculated, and the meaning of the resultant eigenvalues, see http://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors and http://mathworld.wolfram.com/Eigenvalue.html.

The **Analytic Hierarchy Process (AHP)** is a structured technique for organizing and analyzing complex decisions based on mathematics and psychology.

Rather than prescribing a "correct" decision, the AHP helps decision makers find one that best suits their goal and their understanding of the problem.

(Composite layout created from Decision Lens Instructional Materials-used with permission)
More detailed presentations of the derivation of AHP including multiple application examples can be found in:


Additional examples and detailed discussions on the mechanics of AHP can be found at the following websites:

http://www.isc.senshu-u.ac.jp/~thc0456/EAHP/AHPweb.html


Appendix E is an “as is” direct copy of the PDF provided by the Delaware Department of Transportation.

**DelDOT Project Prioritization Criteria Summary**

The criteria selected for the enhanced method of prioritization for projects to be considered for inclusion into the 6 year Capital Transportation Program were based on several factors:

- DelDOT’s Mission Statement, Vision, and Goals
- DelDOT’s current prioritization Process (1998)
- Provisions from TITLE 29 CHAPTER 84 § 8419 of the Delaware Code
- Provisions from the latest Federal Authorization Bill - MAP-21

**The Criteria:**

1. **Safety** (33.0%) – The ability of the transportation system to allow people and goods to move freely, without harm.
   
   This criterion is used to assess the extent to which the Project addresses, maintains and improves safety. (Note: Critical ratio value or program data provided by DelDOT Traffic Section)

   a. Identified in a Safety Program (80%) – This criterion is used to assess the extent to which the Project has been identified as a project in the Hazard Elimination Program (HEP) or the High Risk Rural Roads Program (HRRRP).

   b. Addresses strategies in the State Highway Safety Program (SHSP) (20%) – This criterion is used to assess the extent to which the Project addresses specific strategies in the Delaware Strategic Highway Safety Plan; reducing the frequency and severity of roadway departure crashes, improving safety of intersections and making walking and street crossing safer.

2. **System Operating Effectiveness** (24.8%) – The ability of the transportation system to efficiently move people, goods and services without excessive delay or inconvenience.
   
   This criterion is used to assess the extent to which the Project meets operating objectives as described in the State Strategy and in regional or local community plans. (Note: Score value is determined by existing state data).

   a. Existing Level of Service (LOS) (50%)

   b. Identified as a congested corridor in the MPO Congestion and Management Analysis (50%)

3. **Multi-Modal Mobility, Flexibility/Access** (15.6%) – The ability of a project to provide efficient movement of people and goods between destinations by motor vehicle, pedestrian, bicycle and transit modes (including land side access to airports and marine terminals.)
   
   This criterion is used to assess the extent to which the project addresses transportation choices and allows additional connectivity to the existing system. (Note: Improvement level is defined within rating scale).

   a. Significant Improvement 100% credit u
b. Moderate Improvement 50% credit
c. No Improvement -0- credit
d. Detrimental -0- credit

4. Revenue Generation/Economic Development/Jobs & Commerce (7.9%) – The ability of a project to facilitate or support business development and employment.

This criterion is used to assess the extent to which the Project has the potential to generate revenue or will support economic development and benefit commerce. (Note: Locations or Contributions are determined by existing State data).

a. Located in a Transportation Improvement District (TID) (33%)
b. Degree of Non-State/Non-Federal Contribution (33%)
c. Located in Designated Freight Corridor (33%)

5. Impact on the Public/Social Disruption/Economic Justice (7.2%) – The assessment of the project on the transportation system as it relates to existing communities and population centers.

This criterion is used to assess the extent to which the Project supports investment in existing communities and provides community enhancements such as sidewalks, safe routes to school. (Note: Impact level is defined within rating scale).

a. Positive Impact (100%)
b. No Impact (25%)
c. Negative Impact -0-
d.

6. Environmental Impact/Stewardship (6.5%) – The effect of the transportation system on energy use and the natural environment.

This criterion is used to assess the extent to which the Project mitigates the threat or damage to the environment, including Air Quality. (Note: Impact level is defined within rating scale).

a. Positive Impact (100%)
b. No Impact (50%)
c. Minor Negative Impact (20%)
d. Major Negative Impact -0-

7. System Preservation (5.0%) – Fix It First/State of Good Repair addresses the improvement of the physical condition of existing transportation assets.

This criterion will assess the extent to which the Project contributes towards system preservation and is addressed through an existing preservation program. (Note: Improvements/Impacts are identified through State data)

a. Yes
b. No
Appendix F
Interview Summary Data

Part 1: State Process and Organizational Considerations

Question 1:
Who develops your State-wide Long Range Transportation Plan (LRTP)? What is the balance of in-house staff and consultants? What led to this selection?

Responses:

100% of the responses (26) regardless of who did the plan indicated their choice was made due to financial constraints. If a plan was created by consultants it was due to lack of financial and personnel resources at the agency to do in-house. If the plan was predominantly created by in-house staff it was due to a lack of financial resources to use consultants. The distribution of consultant participation for generating the long range plan was estimated by the respondents for their agency as follows:

<table>
<thead>
<tr>
<th>% Consultant Participation</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>(12)</td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td>(3)</td>
<td></td>
</tr>
</tbody>
</table>

80% of the Long Range Plans were created with more than 50% consultant participant, yet 18 of those 21 (85.7%) that used this degree of outside help stated they would have preferred to have done all in-house. A common phrase heard was “no sense of ownership” within the agency when a majority of the plan was consultant driven. One
comment “you do not hire out relationships” was made by a planner where the plan was developed in-house with only minor outside consultant help for certain technical capability not available within the agency. One planner where the plan was done in-house described the value of using consultants as “consulting quality sucks, not at all useful” and cited this as the reason for doing in-house. Another planner described the decision of using consultants or doing in-house as “the grass is always greener on the other side.”

Question 2:
How does organizational structure affect how a state-wide long-range plan is produced?
Responses:
Only one planner stated that organizational structure does not affect how the long-range plan is produced. The remaining 25 all had mildly negative to highly critical comments as to how their organization structure affected how the long range plan was produced. Selected comments by planners:

“Organization can’t get out of the weeds”
“Trying to overcome silos”
“We call them cylinders of excellence”
“Doesn’t, they just don’t care, period”
“Try to bust the silos, want versus need”
“Board appointed by Governor to remove influence, but they are appointed by the Governor, not so good”
“We don’t actually do much, county driven”
“Yes, no organization, no people, that’s why we use consultants”
“Need to break down silos”
“Huge effort to avoid silos”
“Fractured and broken up”
“Engineering doesn’t understand Planning, and Planning doesn’t understand Engineering”
“No one has any formal training in planning, state HR has no classifications for planning in DOT, only Engineering”
“Isolation and no communications, 25 years went off and there it was”
“Planning is done in a vacuum”
“There is no organizational help, so no impact”
“We are a highway agency, period, and managed that way”
“Org chart blurs over time, try to overcome silos”
“Central office does plan, little input from field”
“No money, planning not considered important anymore”

A recurrent theme across 25 of the 26 interviews was the silo based organization both in authority, intellectual understanding and communications. The literature review had previously established that silo is a common term of art in Transportation industry and referenced as an ongoing problem. The tone in the voices of many of the planners was almost of a “gallows humor” about this issue and a sense of hopelessness yet still trying for change in the face of almost continuous failure.

Question 3:
What do you consider key educational and professional skills for personnel developing state wide long-range plans?
Responses:

Interviewees all gave multiple answers to this question and the response space resulted in five categories being identified. The rounded percentage shown indicates the relative distribution of the 59 responses and the skills identified:

- Communications 49% (29)
- Planning 25% (15)
- Economics 12% (7)
- Engineering 10% (6)
- Land Use 3% (2)

Communications received the highest response as the most critical skill that is missing in developing long range transportation plans. The need for engineering skills was identified by 6 of the 9 engineer planners interviewed. Specific comments included:

- “Engineers have to be trained to bring them to a level of awareness to think in different terms and the element of community- What are you talking about?” (from a non-engineer)
- “Not to be an engineer” (from a non-engineer)
- “Standard planning has no meaning in long range planning, therefore more important to be able to communicate and write.” (from a non-engineer)
- “PE helpful” (from an engineer)
- “AICP or CE helps” (from an engineer)
- “Be nice to have real planners” (from an engineer)

It was initially surprising that little emphasis was given to land use planning as an important professional or educational skill in long range transportation planning. However, the lack of emphasis made sense as the responses to question 12 accumulated,
on what was the relationship or philosophy of long range transportation planning and land use in your state. The preponderance of responses was that there was no relationship. The focus on planning being an important professional skill was referenced with regard to transportation generally and analytic methodologies specifically for long range planning and not the specific knowledge of land use planning. Reference to “home rule” in each case was given as the reason for the isolation and hands off attitude in linking the two areas. In several states, the DOT is legislatively forbidden from being directly involved with land use planning; yet one cannot exist without the other in a functional society.

Question 4:

Is your long-range transportation planning continuous or episodic in nature?

Responses:

26 of 26 indicated it was episodic and a plan done every 5 years, and in some cases stretched to 7 or 8 years. The federal requirement is at least every 5 years and no state did it at a greater frequency. This is logical given the information gained from planning perception questions that the plan is not utilized in practice or valued by the participants. All agreed that continuous (evolutionary) planning was more effective, 23 of 26, 88% stated notwithstanding federal requirements they are trying to change the internal planning process to a more continuous one. That said, they all indicated that lack of staff, lack of funds, and except in two cases, no political support to do anything except the minimum. Comments included:

“Evolutionary planning would be better”

“Yes every 5 years and that’s the only time we ever look at it”
“Really a pseudo plan, need to integrate”

“Management hates this document”

“If not for FHWA we would not do this document”: 4 identical responses

“Not totally ignored, but close”

“Not followed anyway, no meaning”

“Dust on the shelf”

“We do only an internet version now, virtual dust I guess”

“25 years of episodic, long on words short on substance”

Question 5:

How do federal requirements influence your statewide long-range transportation planning process and organization?

Responses:

24 of 26 indicated that federal requirements heavily affected their planning; however none of the 24 indicated it was a positive effect. The two respondents who felt the federal influence was minimal were from states where the federal component of funding was under 30% of their budget. These two Directors felt it was only a positive influence for the national engineering and quality standards (they were both engineers). The collective responses can be described as distain of the federal influence being highly prescriptive with no national mission, and insensitive to unique state needs; one-size-fits-all and too little flexibility. Comments below are per respondent and indicate overall tenor of expression during the interview:

“Mindful of, but under the gun.”
”100% done only to get the money, period”

“If not required, would not do, need more flexibility”

“Too much, would do different, and better, if no Fed influence”

“They gotta have project plans, God! I try to be independent.”

“Follow only to get at the money”

“No national vision, Fed bogs things down”

“We have lifelines to deal with, Fed doesn’t get it”

“Feds and ASSHTO moving to lowest common denominator, they need goals”

“ A lot, but we need asset management, not prescription”

“Minimal just to meet the regs”

“Feds just want to cover what they want to cover, just don’t look too close”

“No, we get very few dollars from them”

“Yes, chained to the will and whims of the national servants, we are 10-15 years ahead of them all.”

“People wish they would go away”

“Color of money bogs down the process. What are they trying to do?”

“Fed drives the Table of Contents of the plan, that’s it”

“Heavily, but of questionable value”

“Fed too slow to change”

“Please go away, had to follow Fed lip service”

“Very strong, we do it only for the money, it’s the Feds, not what we want to do”

“Very much so, but Fed and FHWA not very good”

“Yes, Plans OK, we meet once every 5 years to talk” (laughed heartily)
Question 6:

How is your Statewide Long-Range Transportation Plan used as a policy resource? Is it referred to as often as other planning resources such as the TIPS and STIPS?

Responses:

25 of 26 stated the SLRTP is not used as a policy resource or referred to until the next one is required to meet the federal requirement of a minimum 5 year update. It is listed by reference within the documentation of the TIP and STIP but not actually utilized. One state looks at it once per year in relation to the state of good repair for their highways which has a quality performance measure in their SLRTP that is projected to be met annually; beyond that it is also not used for any policy making. Responses to this question mirrored the frustrations expressed in the previous five questions in trying to do meaningful planning under perceived disjoint regulatory and organizational stresses:

“Put on the shelf”

“We can’t get there if we don’t know where we are going”

“More involvement needed”

“Not used, not referred to, Powers don’t want people to know about the future problems”

“Tried internal poll, nobody knows our own goals”

“Defines sitting on the shelf”

“Don’t do print anymore, now collects cyber dust, but its searchable!”

“Needs to be integrated”

“Previously crap, need to fix”

“A sentence in the STIP, that’s it”

“Doesn’t completely collect dust”
“Should be defining the state’s role”

“No, isolated, people not interested in the future, don’t trust us”

“worthless as shit”

**Part 2: Planning Perceptions**

**Question 7:**

What do you see as the primary contribution of long range transportation planning in your state?

**Responses:**

The responses to this question resulted in five categories of contribution being identified:

- Determining Goals and Objectives 35% (9)
- None 19% (5)
- Identification of corridors 15% (4)
- Financial implications 15% (4)
- Communications Tool 15% (4)

Responses to this question need to be considered in the context of question 6 where 96% indicated the SLRTP is not used in any fashion. All respondents observed that the process was far more important than the actual product. In this question opinions were more personally focused in how the process of long range planning helped the respondents to do their job in some specific aspect, even though all thought the resultant product was of no value beyond meeting a regulatory requirement.
Question 8: Has statewide long-range transportation planning been successful over the past few decades in achieving state objectives? Can you give me examples?

Responses:

77% (20) answered with an explicit “no” to both parts of the question and 23% (6) gave a qualified weak “yes, perhaps, or somewhat”. In each case the respondent was asked a second time to think again if they could identify an example. 20 remained at no and the other 6 gave the following examples:

“laid out some options”

“compared to the last 50 years no, but last year it helped pass the sales tax referendum”

“Yes because it points out financial doom” (said with great laughter)

“Yes, well no, not really”

“Sort of, helps closing gaps in funding and projects”

“Somewhat, nobody knows”

The responses amplify how weak the prescribed long range planning process has been and continues to be. No one could give a specific infrastructure example of success, The majority of the interviewed planners have seen 4 cycles of the federal planning process.

Comments included:

“Complete farce”

“Its impossible”

“Previous Governor did not want public to know any of the facts, no negative press”

“Planning lost, generally not recognized, only self satisfaction”

“Nobody knows”
Question 9:

What issues do you see affecting the success of future state-wide long-range transportation planning? What do you consider the highest risk and the greatest uncertainty?

Responses:

Five categories were identified which characterized the answers to this question.

Several planners had more than one concern in answering this question:

- Funding, finances 57% (20)
- Federal control, inflexibility, policy scale 23% (8)
- Intellectual capability, staff 11% (4)
- Energy 11% (2)
- Climate change 3% (1)

Lack of staff and the ability to hire the right people for the right job was identified separately by the planners as being the result of reduced budgets so this also is funding related issue. The subject of federal control inflexibility and lack of scale considerations in policy was also a theme present in answers to questions 2 through 8. Specific comments made:

- “Pie not big enough”
- “Building things we don’t need since no flexibility in Fed rules”
- “How far on a limb are we willing to go?”
- “Wrestling with meaning of transportation, what does it mean?”
- “Federal ambiguity”
- “Deterioration is continuous”
“The people who write these regulations don’t know, they are unplugged from reality”

“Money, period”

“We are odd balls, planning only one who thinks down the road”

“Government is suppose to support stability, so change is hard, institutional memory hard to change”

Question 10:
Are you familiar with the long-range planning processes in other professions (such as power, aerospace, defense, etc.).

100% NO.

Question 11:
Compared to other planning activities how is long-range planning valued within your organization?

Responses categories developed:

- No value now and in future: 58% (15)
- No value now, hope for improvement 35% (9)
- Don’t know 4% (1)
- Good, perhaps 4% (1)

Except for 2 planners, 24 uniformly responded that the activity was not currently valued within their organization. One didn’t really know and the other was the only one who said he “thought it was good, but not sure, don’t know.” 15 of the 24 “no” group as of the time of the survey felt long range planning continued to have no perceived value in their organization and that was not going to change. 9 thought there was reason for hope
with recent changes in either Governors, Secretaries, or Commissions; however there was no tangible evidence of this hope except in 3 cases. Comments were:

“No one values it, it takes away control”

“Not seen as valuable”

“Plan is not valued, process is”

“Only valued to a legislator if it involves economic development”

“Was crap, getting better”

“No, planning- What is it you guys do?”

“Others more important, but we do matter”

“Planning is not valued, SLRTP valued even less”

“Elected officials don’t care, do as they see fit”

“On a scale of 1 to 10, a 5 if we bring in money”

“Low, not seen as valuable”

“Bad, getting somewhat better”

“Not worth shit 5 years ago, getting a little better”

“Bullshit”

Question 12

How would you describe the planning relationship or philosophy between long-range transportation needs and land use in your state?

Responses:

24 of 26 responded that there is no relationship or philosophy between land use and transportation needs within their state. The two exceptions represented the extremes
in the characteristic of the states surveyed. The state ranked 1st in highest population density in the United States responded that land use and transportation are “very tightly aligned;” however that state only controls 5% of its transportation network and is rated in the bottom ten states in terms of highway quality. The other state is ranked 50th in population density and 80% of its land is under the Federal Bureau of Land Management, and they have no direct control or involvement in that land use. It is rated in the top ten of states for highway condition. When the federal land is removed from the calculation both states end up being of nearly identical size.

The comments made on long range planning by all respondents all dealt directly with the long running dialog and issues on the philosophical differences between centralized planning and control versus distributed planning and control. Regardless of the challenges, all the planners felt that dialog and engagement was in the best interest of all concerned, even though there were certain political risks due to the battle cry of “home rule.” One planner said “The state may think it has a transportation plan, but there are 2,600 local jurisdictions who think otherwise.” The use of the words “trust” and “fear” were used repeatedly by all respondents and referenced the ability of the DOT to invoke eminent domain for projects as a major source of that fear.

Balance of Comments:

“Breaks in logic, no connection”

“Tension, none”

“In part people have to accept losses with informed decisions”

“None, stay out”

“None, education has to break cycle”
“Not much, private, stay out”

“No, at least ability to have a conversation?”

“No, need collective vision”

“No, stay away”

“No, hard”

“No, very limited”

“Very aligned, but we only have 5% of infrastructure, we need new words to replace smart growth”

“No disconnected”

“Huge disconnect, no policy”

“None, need to show relevance”

“None”

“None, home rule”

“None, stay away and don’t cross the line”

“None, don’t do, 80% Bureau of Land Management, odd ball.

**Part 3: Methodology Considerations**

**Question 13:**

Linear extrapolation of historical trends to predict future needs has long been utilized for developing state-wide long range transportation plans. Is this what you do? If not, what do you do? Has it been successful? Can it be considered an effective method for future long-range infrastructure planning?

**Responses:**

One respondent had to curtail the interview early and only 25 responses were available for analysis. The responses were unanimous (25 of 25) in saying that the use of linear extrapolation of historical trends for developing state wide long range
transportation plans has not been successful and it should not be used as the method for future planning. That said, 17 of 25 (68%) continue to use it as their primary long range planning tool even after acknowledging its shortcomings and that it should not be used. For the remaining 8, 7 are in the process of implementing some form of scenario modeling using tentative words to describe the process as “toying, trying, long way to go.” The range of the 17 opinions for those continuing the use of linear extrapolation:

“Yes, it doesn’t work, yes we still use it”

“Yes, it doesn’t work”

“Yes, don’t know what else to do”

“Yes, leadership really doesn’t know”

“Yes, don’t know any other way to do it”

“Yes, who ever saw traffic falling?”

“Yes, not sure what to do”

“Yes need more flexibility”

“Yes, too many people in the black box and you end up with way out situations. We have Bob Burchell evaluate it.”

“Yes, and you are sure to be wrong”

“Yes and not very good, we need to innovate”

“Yes, it isn’t accurate”

“Yes and not very good, we do it to satisfy the Feds”

“Yes, trying to change”

“Yes, didn’t work, moving to state wide modeling, but not yet started”

“Yes, some Delphi, but random”
“Yes, population driven”

Question 14:

Climate change has become a major international political and social issue effecting policy decisions for virtually all aspects of life. What are the implications of climate change on state-wide long-range transportation planning?

Responses:

The respondents’ range of answers to this question mirrored the divide in public opinion on climate change in the United States. Only 25 planners were in this question pool. The answer from each planner:

“Big issue for us. We are the canary in the coal mine, bluffs collapse, perma- frost melting, sea ice change, more high altitude landslides, and three 500 year snow events in one year.”

“Don’t know yet trying to figure it out”

“Not considered, trying to figure it out”

Struggling, huge policy discussion”

“Bunch of bullshit, I don’t buy into it”

“Reality is its happening. Need incremental change”

“Climate change is recognized in planning, but it is not to be discussed at a state level. We are a conservative state, it doesn’t exist”

“No, political climate does not recognize it”

“We are probably ahead of the other states. We have lost 13 islands in past 100 years”

“Significant FHWA says, yes, but no focus, not together. We are all vulnerable and part of it.”

“Don’t know. Would not be an issue if we had no-emission vehicles”
“Don’t know, tasked to determine”

“Not a focus for us, other agencies deal with it”

“Will be a special challenge, need to integrate,” reference to other agencies.

“Previous Governor yes, current Governor no, we are oil patch”

“A struggle, we can’t do what really needs to be done. FEMA, USDOT classifications are not flexible enough, can’t do the right thing”

“Largest source of GHG, ozone ppm, we are trying but need more flexibility from Feds”

“Nibbling, we need to shed more light”

“Great question. I am waiting for guidance”

“Still investigating, trying to figure out, solution probably more involvement with land use”

“Interesting question. We are a coal state, doesn’t exist”

“Yes, fits and starts. Revenue has to get off gas tax as a funding source”

“Very gross level. Governor’s strategies done in isolation, not meaningful, no commitment”

“Yes, can’t tell yet. Big energy state, no real position from Governor”

One might expect that if a state was considered politically conservative and/or an energy producing state, that support for climate change as a consideration in long range transportation policy might be limited. The survey results supported this assumption with one significant exception. If a politically conservative or energy producing state has directly experienced a recent major negative event or succession of events attributed to global climate change; they are supportive.
Question 15:

How long do you think the planning horizon should be for a long-range plan? Why?

Responses:

Only 25 states are in this question pool. For this question there was no consensus on the best planning horizon and very divergent opinions on what the horizon selection is intended to achieve.

“Nothing magical about 20 years. Projects need to be 10 years or more. Black swan events do happen. You have to have your feet in two worlds. 5 years realistic, 10 years intermediate and 20 years long.”

“Difficult to do revenue out 20 years. 10 years more realistic. Need federal changes.

“Next 20 year plan with 50 year notes (bridges). Some feel 50 too long, but it can’t hurt”

“50 year vision should build in options for us, 10 year strategic. STIPS and TIPS not long enough”

“5-6 years. I don’t really know, by the time you get buy-in its too late!”

“50 years? I don’t know. We have no basis”

“25 is good. Talked about 50 and was laughed at, settled for 30!”

“Why, can’t plan beyond funding. MAP-21 may help”

“20 years minimum, more than that and you have the “Jetsons”

“Why not 100 years, the paper industry does it? But when longer it becomes less real. Need to depoliticize the discussion”

“Data needed to determine. Doing 10 already, lose participation at 10 and 20”

“Difficult to put your head around. Make 100 years?, 30 is difficult enough, good as any”
“20-25 horizon. 7-10 for projects”

“20 is fine. Don’t know how you use 50 years. We have the worst FHWA planner in the United States, can’t think outside the regulations”

“20-30 years. Previous long range plans, most projects still not built. Most can’t fathom that far out and still not built?”

“What would be the basis for validity? How do we know? No one believes us anyway. Beyond 20 years is crystal balls, too pie in the sky”

“20 year minimum, 25 OK, 10 too short. Too long and it loses vitality”

“Nobody shows up for long range planning meetings. Practical should be 5-10 years for most things and 50 for others (referred to environmental).

“20 not bad but most can’t relate”

“20 is enough. 50 years for life span infrastructure, 10 or more other”

“Comfortable with 20 years. In state must have by law a 12 year program, but not good enough, 20-25 certainly of value. Long range plan is isolated, need to tie into 5-6 year plan”

“Gut reaction is 10 years. Makes it more relevant. 50 years is a question of practicality”

“20 years OK. Far as I can think is too far out, can’t do, detached from reality. Vision needs to be 30-40 years out. Dollars short term, Vision long term”

“Used to favor 20 year horizon, now not so sure. Socio-economic 25-30 years. VMT drop off who ever saw that”

“Advocate for 20 years but determined by state. More important than horizon is updating, 5 years too long. Should not be fits and starts. Keep it rolling forward. Needs to be meaningful. If we are going to build hard infrastructure we have to be upfront”
20 years is working OK. 10 years for projects makes sense. Scenarios for 20-50 and set short/mid/long project buckets”

“Nuts and bolts 5 years. Performance indicators 15 years. Bridges 50 years. Go 20-30 on population, environment”

The collective responses to the planning horizon question and what type of planning it should be must be considered in the context of how these same planners all answered that they have no knowledge of long range planning methodologies outside of transportation. They are bounded by their experience which was shown to be overwhelming only in the transportation industry and 88% within their own agency.

One respondent made reference to the paper industry using 100 years as a planning horizon that he accidently learned about while on a vacation trip with a friend. In Germany the paper industry is required by regulation to use a 200 year planning horizon. This is not a recent regulation. It was instituted in the late 19th century to assure the continuing availability of the German forest as a resource. The horizon represents approximately three times the life expectancy at maturity for the predominant Birch species that is harvested. Regulations or royal decrees in Europe go back as far as the 15th century on forest harvesting and implied duration based on growth and replenishment to maintain availability (Green 2006). Compared to current federal regulation and actual planning horizons used or perceived by the interviewed planners, there is a lack of understanding for the relevance of the scale of time and its applicability to their own infrastructure life cycle. Infrastructure is being built with 100 year life expectancies and long range planning limited to primarily a 20-30 year horizon. Notwithstanding disagreement on duration there was consensus that whatever the horizon selected, the planning should be a continuous process as confirmed by question #4 responses.
Question 16:

Statewide long-range transportation plans can generally be classified into one of five planning philosophies: Needs, Vision, Policy, Project, or Corridor. What does your state use and why was this particular method chosen over the others?

Responses:

This was a classification question and confirmed the current distribution of the 25 plan types:

- Needs 4% (1)
- Vision: 36% (9)
- Vision corridor 4% (1)
- Vision Policy 4% (1)
- Vision Needs Policy 4% (1)
- Vision Needs 4% (1)
- Policy 20% (5)
- Policy corridor 20% (5)
- Project 0% (0)
- Corridor 5% (1)

These responses agree with the results of the Volpe study on current types of SLRTPs. However, the responses in this research survey indicate that all the sampled states are moving to primarily Vision based long range planning and away from the other types. The migration being motivated by the desire to minimize political risk, and reduce financial burden and staff time to produce and not because of any perceived enhanced
value for determining policy options compared to previous approaches. Only a few respondents commented in depth on this issue with most simply confirming their current plan type and their next plan type selection:

“Feds as partners- thank you and good bye”

“But we are facing doom, whatever we build we can’t control”

“The shorter the better”

“Preselected wish list, Commission Director hates it”

“Project based going the way of the Dodo”

“Politically it’s bring me a rock, but not that rock. Very tough to do”

Question 17:

SAFETEA-LU and TEA-21 requires state-wide long-range plans to consider 8 planning factors

(I will state these in the interview). Have your planning tools and methods been equally successful in informing future policy decisions for each factor? Are there any specific major strengths or weaknesses?

a) Economic Vitality
b) Safety
c) Security
d) Accessibility/Mobility
e) Environment
f) Integration/Connectivity
g) Management/Operation
h) Preservation

Responses:

The intent of this question was to determine the relative quality and applicability of various primarily analytical tools and methods used to evaluate the required federal planning factors in developing policy. The assumption was made in the formulation of the question that Planning Directors would have firsthand knowledge of the explicit
techniques utilized in the tools and methods that shaped their policy selections. The assumption proved to be in error.

The dialog with the respondents became more of a generalized discussion on dealing with these issues from a higher managerial perspective. The results of the actual discourse were perhaps more valuable than what the original question was designed to elicit. Only 23 responses are available for this question as 3 respondents needed to cut short the interview due to other priorities.

Grouping of the major responses into related categories of highest perceived difficulty:

- All hard 19% (5)
- Economics related 54% (14)
- Security 27% (7)

Security was raised as a concern for clarity of what it means. Instituted by the USDOT after the 9-11 attacks as a separate planning factor, all felt it is a part of safety. Economics was identified as the hardest to quantify vis-à-vis vitality. Although all felt there is significant general financial and economic data available the issue was more one of problem statement and measurement definitions.

- “Safety we have excellent data. Problem with the rest is the Feds do not understand scale.”
- “All difficult, economic vitality is the hardest”
- “Very difficult to deal with, economic vitality hardest”
- “All important, can’t really pick one. Without finances all the rest don’t make any difference”
- “Don’t know, management not involved”
“At a state level don’t know how to quantify. Hard to translate any of them into something useful. Fed transportation bill needs a national interest”

“Economic vitality is hardest. Can’t demonstrate that transportation is an asset with current funding bill”

“Economic development. Authorization doesn’t make a good case for the country. Why is transportation critical?”

“Economic is best data, but hard to do. Integration and connectivity is weakest.

“Not sure”

“Go away. Regs say this way, don’t do just to do. Performance measures needed”

“They have a narrow view. Feds and AASHTO create problems. No national focus. Let states have more flexibility”

“MPO driven. Some state modeling in 2001. Don’t know”

“Of the goals safety most important. I would bring in other disciplines, Public Health. Transportations scope of work too limited”

“Economic development, too many prescriptive fundings. Insufficient state flexibility”

“All involved. Security is at bottom of list, safety number one. Economic vitality is jobs. Fix it first before building”

“Economic is hardest. Need better tools. Hoping AHP will help but have not grasped it all yet.”

“Security, don’t know. Economics handled by another department. Preservation is our highest priority”

“Hard to define. Need analytic approach to prioritization. Economic vitality and security hard to define. Federal priorities are no aligned”

“Economic most challenging”

“Economic vitality. We know safety. The Feds don’t know outreach, push more links, but in practice the regulatory agencies are uncooperative- need to talk about that”
“How do we connect the public and how we move is missing”

“Economic development, we lag here”

**Part 4: Demographic/Background Information**

Question 18 and Question 19 are combined for presentation:

**Question 18:** How many years have you been involved in transportation?
**Question 19:** How many years have you been with your current organization?

Responses:

<table>
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<tr>
<th></th>
<th>Transportation Industry</th>
<th>Current Agency</th>
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<tr>
<td>The average career time:</td>
<td>23.1 years</td>
<td>21.3 years</td>
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<td>Minimum</td>
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<tr>
<td>Median</td>
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<td>25</td>
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Cumulative Industry experience: 600 years
Cumulative experience in Planning Agency: 554 years
Total working experience of any type: 628 years

In the total sample for career experience outside of transportation, the “outside” 28 years came from only two respondents (20 years for one and 8 for the other). 95.5% of total career experience was limited to transportation for all respondents and 88.2% had no experience outside of their transportation agency employment. Individual experience is showing as being highly vertical in scope and limited to one industry and one employer in that industry. The survey respondents uniformly replied to Question #20 that their undergraduate education did little to prepare them for managing or doing long range planning. The respondents also indicated that the predominance of their practice knowledge came from on the job or in-house training and experiences. The careers of the
respondents are shown to be overwhelmingly limited to transportation generally and long
term tenures with their individual state agencies specifically.

Question 20:
What is your educational background? How did you find the experience prepared you for
working in state-wide long-range transportation infrastructure planning?
Responses:
Seven education classifications were developed:

- Engineering Related 35% (9)
- Economics Related 31% (8)
- Environment Related 8% (2)
- Transportation Planning 4% (1)
- Anthropology 4% (1)
- Philosophy 4% (1)
- Political Science 4% (1)

Regardless of specialty, 100% of respondents indicated that their undergraduate
education did not prepare them for dealing with long range planning or management.
Responses:

“Didn’t, perhaps conceptual understanding with my MS in Regional planning”

“No” (3 respondents gave single word responses)

“Probably analytical side, but no.

“No, problem solving”
“No” (laughing)

“No, had no idea. Planners are separated from engineers, they are wired differently”

“No, more of an analytical view?”

“No, basic land use”

“Somewhat but not much, no”

“No, but I think working with public is critical”

“No, but MA in Screen Writing taught me how to write”

“It didn’t, learned some lingo that was it”

“No, more from my business experience”

“Not enough to matter”

“‘I didn’t think it directly helped”

“No, only some writing and statistics

“No, MS probably helped on project implementation”

“No, data analysis”

“No, MBA some organization and economics”

“No, here to reach a certain level you need to be a PE”

“No, M.S somewhat”

“No, all OJT”

“No, MS in Paleontology about people”

“BS no, MS yes as to thinking at a more worldly level”
Question 21:

How would you characterize your professional status (planner, engineer, sociologist, etc)? How do you think this affects your perspective on planning?

Responses:

This question always drew the same initial response from all respondents: “Interesting question, never really thought about it” The ultimate responses were:

“Champion of change”

“Plan-gineer”

“Engineer, only Director for 1 month”

“Cat herder”

“Right wing planner- need less government”

“Policy Analyst”

“Manager”

“Manager mostly”

“Evolving , more of a Sociologist Mentor”

“Planner” (5 total identical)

“Facilitator”

“Fireman, always putting out fires”

“Planner and Engineer”

“Business Person”

“Director of stuff”

“Articulator”

“Manager and play at being an Executive”

“Jack of all trades”
This question was posed to be used in additional research after the dissertation as a basis to further evaluate how perception and attitude of self affects manager’s attitudes toward change within a planning environment notwithstanding their functional classification.

Question 22:
In transportation terms how would you describe the area where you grew up? Do you think this influenced your philosophy on planning?

Responses:

“Very suburban Southern California, learned to hate it. Quickly learned never again. Moved at 16 to Seattle the jump off point to Alaska.”

“How suburban Texas Then 8 years in a rural area. No real perspective, hasn’t affected my views. Perhaps better linking of multi-modal solutions within land use.

“Born in china, moved to US 17 years ago. Arkansas very different! Need to align transit and development.”

“Never thought about it”

“Long Island. Walked everywhere, high school. No side walks but there were shoulders, didn’t feel unsafe. Paths to transit. Yet when you lived in NJ drove everywhere. Nice to have sidewalks and should plan for the environment.”

“Western Virginia. Have lived in really small, medium and large cities. Really good exposure. Frustrated as engineers only interested in highways” (respondent an engineer)
“Metro Atlanta. Saw what development can do and prevent what should have happened. So many parts and agendas. A complicated environment, past segregation shaped growth.”

“Son of a Pastor, moved a lot. Didn’t really think about it, but Kansas is never congested!”

“Mostly Maine. Have seen both worlds, gave me a perspective and to cherish Maine and avoid over development if you don’t plan well.”

“Grew up in suburbs, lived in city. Probably biased more toward urban.”

“Suburban outside of Boston. No impact.”

“Small town in up state New York, Seneca Falls, beautiful. Had to walk everywhere, my mother did not drive.”

“Ryal, Mississippi, never thought about it. We do not have traffic congestion, not Atlanta!”

“No. Grew up in suburbia.”

“Small town, may affect how I deal with people, but mostly career at DOT”

“Asbury Park and Trenton centric. Definitely saw effect of land use and it steered me toward planning.”

“Very definitely. Saw how development made quality of life worse decided to go into planning.”

“Grew up and never really thought about it. I grew up in utopia, saw many worlds.”

“NO impact. Lived in suburban area then rural.”

“Rural area and right before my eyes saw it evolve. Broad perspective on linkage with land use.”

“Suburban Florida, greater appreciation of open space and multi-modal.”

“Yes. Grew up early in city walked, transit. Moved to country in 70s and drove everywhere. Need to control sprawl. I have an aunt
in her 70s stays active, walks everywhere, ability to access stuff. Value in independence and density versus unmanaged. Transportation needs to build communities not just corridors.”

“Not sure, grew up in Charlestown, never left.”

“Grew up in Southeast Texas. probably thought about planning and transportation when the large highway went through and I got on the overpass and said, wow, a high on flat terrain!”

“Very urban neighborhood in MN. Has led to my interest in urban problems. Rural biased Midwest drive perspective- 600 miles to anywhere.”

“Very rural Wyoming, never left state, roll my eyes about growth.”

Summary classifications:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Percentage</th>
<th>Count</th>
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<td>4</td>
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<tr>
<td>Not thought about it</td>
<td>11%</td>
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</tbody>
</table>

Question 23:

What is your current primary commute distance and modal choice?

Responses:

Primary commute distance: Average: 14.5 miles
Shortest: 2.0 miles
Longest: 70.0 miles

25 (96.1%) drive an single occupant vehicle to work (minimum 2 miles) and 1 takes a bus and subway (9 miles). Of the 25 who drive, only 8 (32%) had an available option of bus transit or rail and walking or biking but decline use for the following reasons:

“Too time consuming, lack of freedom”
“Doesn’t match my needs”

“Not bike or walking friendly”

“Not convenient to my lifestyle”

“Train takes too long and I have kids. Good intent, but.”

“Bus is impractical” (reference to time required)

“Bus is option but not convenient”

“I do have bus access, but it’s the time”

These eight respondents unprompted all started to apologize for using an SOV when there were other options available when this question was asked.

Question 24:

What is your age?

Responses:

The average age of the respondents: 48.7 years
The youngest respondent: 33
The oldest respondent: 65
The mode: 42
The median: 49.5

Question 25: Gender:

(known from participant survey list).

10 females
16 males

Total female directors of planning in 50 States: 12 (24%)
Total male directors of planning: 38 (76%)

Percentage of females in sample: 10 (38%)
Percentage of males in sample: 16 (61%)

Percentage of all female directors in population represented in sample: 83%
Percentage of all male directors in population represented in sample: 42%
Closing Comments

At the end of each interview after thanking the respondent for their time and participation, they frequently made an unsolicited comment on the overall interview experience or a closing bit of information they wished me to have:

“Problem with feds is they don’t understand scale. Problem with Feds we face on funding, like funding our ferry system is ours doesn’t contribute to congestion mitigation as New York City ferry system did and the basis for performance measurement and qualification for federal funds. We took Secretary Ray LaHood on a ferry ride and then proceeded to tell him the next stop was about 1,000 miles, connecting a local tribe on the remote island and the only access, funding was released.”

“They are fully prepared in 2013 to deliver the transportation system of 1962!” (Said in reference to the USDOT)

“We have a fiscal year that is July 1 so we are always ¾ year behind the Fed.”

“Fed transportation bill needs a national interest”

“Issue is reduced resources, people and money. (DOT Name deleted) is losing people, perception is transportation is not the place to be. Experienced people leaving. Great to talk to somebody who actually enjoys planning!”

“I have one new position and I am trying to defend, why are you, then why aren’t you, lack of trust.”

“Planners need to lead the outreach. Why care about tomorrow? Work on public outreach. TRB doesn’t get it.”

“Must listen more, but harder to focus, Twitter! What is focus? Legislature was told five years ago, money would run out, and now it has, every legislator acted surprised!”

“FHWA division director is no help, don’t like him. Makes it hard to do better effort.”

“FHWA and TRB need to pay more attention, don’t know what they are talking about”
“Fight over CMAC funds. Not able to fund the stairs down to the subway, not considered transportation, insufficient flexibility.”

“Stress of this job, no time to do planning, miss lunch, can’t sleep. I thought I would hate this phone call, but really enjoyed it, thanks.”

“Scared most by Feds and MAP-21, blanket approach to fit all states- outcomes, we are a rural state.”

“Language, great, but what do you mean? What is important local need versus scale. Want to see things get better.”

“I was the first woman Director of Planning in 104 years.”

“Fed as partners? Thank you, good bye, they don’t understand scale.”

“It’s a government document, not accurate, academic, not advocacy, welcome to the real world, we are a nation of profit.”

“FHWA and TRB need to pay more attention, they don’t know what they are talking about.”

“What scares me most is MAP-21, fear of Feds blanket outcomes to fit all states”

“Planning has more of an important ethical component as long as you are open. Engineers have more credibility but don’t get it.”

“Planning has become too political, primate behavior, kill off offspring of previous head Baboon.”

“Remember those little books you had when you were kid, thick cardboard pages and simple, just a few pages. That’s what we need, shorter and better, not confusing.”

“Do less with less. I feel like a short order cook in a soufflé world”
Appendix G
Title 23 Federal SLRTP Guidelines

§ 450.214 Development and content of the long-range statewide transportation plan.

(a) The State shall develop a long-range statewide transportation plan, with a minimum 20-year forecast period at the time of adoption, that provides for the development and implementation of the multimodal transportation system for the State. The long-range statewide transportation plan shall consider and include, as applicable, elements and connections between public transportation, non-motorized modes, rail, commercial motor vehicle, waterway, and aviation facilities, particularly with respect to intercity travel.

(b) The long-range statewide transportation plan should include capital, operations and management strategies, investments, procedures, and other measures to ensure the preservation and most efficient use of the existing transportation system. The long-range statewide transportation plan may consider projects and strategies that address areas or corridors where current or projected congestion threatens the efficient functioning of key elements of the State's transportation system.

(c) The long-range statewide transportation plan shall reference, summarize, or contain any applicable short-range planning studies; strategic planning and/or policy studies; transportation needs studies; management systems reports; emergency relief and disaster preparedness plans; and any statements of policies, goals, and objectives on issues (e.g., transportation, safety, economic development, social and environmental effects, or energy) that were relevant to the development of the long-range statewide transportation plan.

(d) The long-range statewide transportation plan should include a safety element that incorporates or summarizes the priorities, goals, countermeasures, or projects contained in the Strategic Highway Safety Plan required by 23 U.S.C. 148.

(e) The long-range statewide transportation plan should include a security element that incorporates or summarizes the priorities, goals, or projects set forth in other transit safety and security planning and review processes, plans, and programs, as appropriate.

(f) Within each metropolitan area of the State, the long-range statewide transportation plan shall be developed in cooperation with the affected MPOs.

(g) For non-metropolitan areas, the long-range statewide transportation plan shall be developed in consultation with affected non-metropolitan officials with responsibility for transportation using the State's consultation process(es) established under §450.210(b).

(h) For each area of the State under the jurisdiction of an Indian Tribal government, the long-range statewide transportation plan shall be developed in consultation with the Tribal government and the Secretary of the Interior consistent with §450.210(c).

(i) The long-range statewide transportation plan shall be developed, as appropriate, in consultation with State, Tribal, and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation. This consultation shall involve comparison of transportation plans to State and Tribal conservation plans or maps, if available, and comparison of transportation plans to inventories of natural or historic resources, if available.

(j) A long-range statewide transportation plan shall include a discussion of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the long-range statewide transportation plan. The discussion may focus on policies, programs, or strategies, rather than at the project
level. The discussion shall be developed in consultation with Federal, State, and Tribal land management, wildlife, and regulatory agencies. The State may establish reasonable timeframes for performing this consultation.

(k) In developing and updating the long-range statewide transportation plan, the State shall provide citizens, affected public agencies, representatives of public transportation employees, freight shippers, private providers of transportation, representatives of users of public transportation, representatives of users of pedestrian walkways and bicycle transportation facilities, representatives of the disabled, providers of freight transportation services, and other interested parties with a reasonable opportunity to comment on the proposed long-range statewide transportation plan. In carrying out these requirements, the State shall, to the maximum extent practicable, utilize the public involvement process described under §450.210(a).

(l) The long-range statewide transportation plan may (but is not required to) include a financial plan that demonstrates how the adopted long-range statewide transportation plan can be implemented, indicates resources from public and private sources that are reasonably expected to be made available to carry out the plan, and recommends any additional financing strategies for needed projects and programs. In addition, for illustrative purposes, the financial plan may (but is not required to) include additional projects that would be included in the adopted long-range statewide transportation plan if additional resources beyond those identified in the financial plan were to become available.

(m) The State shall not be required to select any project from the illustrative list of additional projects included in the financial plan described in paragraph (l) of this section.

(n) The long-range statewide transportation plan shall be published or otherwise made available, including (to the maximum extent practicable) in electronically accessible formats and means, such as the World Wide Web, as described in §450.210(a).

(o) The State shall continually evaluate, revise, and periodically update the long-range statewide transportation plan, as appropriate, using the procedures in this section for development and establishment of the long-range statewide transportation plan.

(p) Copies of any new or amended long-range statewide transportation plan documents shall be provided to the FHWA and the FTA for informational purposes.
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