INCORPORATING SUSTAINABILITY INTO NYSDOT’S DECISIONS

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ABSTRACT

Introduction
Transportation decisions are largely driven by economics and, to a lesser extent, environmental and social factors. Though, transportation decisions have shifted in the last 15 years to more fully consider environmental factors (i.e., NYSDOT’s “Environmental Initiative”), the three factors of sustainability (environment, social equity and economics) are often presented as competing factors rather than harmonizing factors in the decision-making process. Addressing all three realms on equal footing will go a long way to ensure balanced decisions and to streamline processes.

Methodology and Results
New York State Department of Transportation (NYSDOT) is taking sustainability to a new level, incorporating the “Triple Bottom Line” thinking (economic, social, environmental) beyond the operational level (the “how”) and the more tactical level (the “what”) by expanding it to a strategic level (the “why”).

NYSDOT recognizes that sustainability is an overarching principle. This paper will touch on NYSDOT’s sustainability ethic established through its GreenLITES (Green Leadership in Transportation and Environmental Sustainability) program and highlight NYSDOT’s recent efforts to incorporate sustainability principles into its asset management, comprehensive program update and capital investments decisions.

Conclusion
NYS is working to refine innovative tools to ensure strategic, tactical and operational transportation decisions that further social, economic and environmental sustainability. Our goal is to integrate ecological, structural, safety, and economic needs into the transportation decision-making process.
TRANSPORTATION SUPPORTING A SUSTAINABLE SOCIETY

New York State Department of Transportation (NYSDOT) is taking action on several levels to embrace its role in supporting a sustainable society. As evident in the Department’s mission statement -- “It is the mission of the New York State Department of Transportation to ensure our customers - those who live, work and travel in New York State -- have a safe, efficient, balanced and environmentally sound transportation system.” -- NYSDOT understands sustainability is about balancing what is beneficial to people while considering what is economically sound and environmentally compatible.

NYSDOT defines sustainability in its working sustainability vision, mission, definition and overarching strategies drafted as follows:

**NYSDOT Sustainability Vision**: Exemplify how transportation supports a sustainable society.

**NYSDOT Sustainability Mission**: To fully integrate sustainability into the Department’s decisions and practices in planning, designing, constructing, maintaining and operating New York State’s transportation system. NYSDOT will also model and advance sustainability in managing its internal resources.

**NYSDOT Sustainability Definition**: Consistent with the Brundtland Commission sustainability definition (World Commission on Environment and Development 1987), NYSDOT understands that a sustainable society manages resources in a way that fulfills the social (community), economic and environmental needs of the present without compromising the needs and opportunities of future generations.

A transportation system which supports a sustainable society is one that:
- Allows individual and societal transportation needs to be met in a manner consistent with human and ecosystem health with equity within and between generations.
- Is safe, affordable, accessible, operates efficiently, offers choice of transport mode, and supports a vibrant economy.
- Protects and preserves the environment by limiting transportation emissions and wastes, minimizes the consumption of resources and enhances the existing environment as practicable.

**Over-arching Sustainability Strategies**: NYSDOT will advance sustainability by following these strategies:
- Develop, advocate and advance Department sustainability goals and strategies through interaction with Main Office and Regional employees, program areas, workgroups and external stakeholders.
- Incorporate sustainability concepts into the Department’s procedures, investments, policies, manuals, specifications, programs, projects and practices.
- Use the Sustainability Steering Committee as a feedback loop so that constructive participation is vetted through Executive Management.
- Develop and use sustainability measures and indicators to better manage NYSDOTs internal resources and programs.
- Facilitate partnerships through sharing of ideas and best practices.
- Evaluate the costs and benefits (societal, environmental, and economic) of transportation investments over life-cycles as well as fiscal cycles.

**CONSIDERING SUSTAINABILITY AT ALL LEVELS OF DECISION MAKING**

Sustainability in transportation systems is explored in work by Jeon and Amekudzi (2005). They found there is no standard way in which sustainable transportation is considered. However, the three-
dimensional framework of economic development, environmental preservation, and social development is the substance of several definitions of sustainable transportation and other infrastructure systems (Jeon and Amekudzi 2005). Deakin’s (2001) working paper on sustainable development and sustainable transportation notes that, increasingly, the idea of sustainability has come to be understood as a collective process for considered decision-making and action, and not simply a particular end-state or outcome.

Fundamentally, sustainability is about making responsible decisions, considering the implications of our actions now and into the future. There are three levels of management decision making: strategic, tactical and operational (Encyclopedia of Business and Finance, 2001). To truly be integrated into an agency’s culture, sustainability should be factored into all three levels.

- Strategic decisions (the “why”) set policies and define overall objectives, are comprehensive, long term, and relatively general. Strategic decisions focus on the broad, enduring issues for ensuring an agency’s effectiveness over a long period of time.
- Tactical decisions (the “what”) focus on more intermediate-term issues such as interpreting policies and objectives, and providing guidelines for operational decision making. The tactical planning in an organization is more specific than strategic planning, dealing more with issues of efficiency rather than with long-term effectiveness.
- Operational decisions (the “how”) are focused, short term, and specific. Operational decisions focus on day-to-day activities within the agency such as efficient, cost-effective application of resources to solving problems and meeting objectives.

By making environmentally, socially and economically responsible decisions at all levels, transportation agencies can play a vital role in supporting society and the greater good.

**Putting Our Money Where Our Mouth Is -- Incorporating Sustainability into NYSDOT’s Comprehensive Program Update and Capital Investment Decisions**

As NYSDOT’s approach to sustainability matures, it is evident that a more strategic approach is essential to truly integrate sustainability principles into all that we do. To that end, NYSDOT is taking action to incorporate the “Triple Bottom Line” of sustainability in its programming and investment decisions, factoring economic, environmental and social aspects into its comprehensive program, asset management and capital investment decisions.

According to AASHTO, “America’s transportation system has served us well, but now faces the challenges of congestion, energy supply, environmental impacts, climate change, and sprawl that threaten to undermine the economic, social, and environmental future of the nation.” (AASHTO 2009).

Understanding this, NYSDOT recognizes it is essential to choose a course of action that preserves our extensive transportation system in a sustainable manner. NYSDOT is adopting a strategy to develop a sustainable program, one that maximizes return on investment, extends the life of its assets, and provides its customers a safe, reliable, balanced and environmentally sound transportation system.

NYSDOT’s Comprehensive Program Update, through strategic investment in its transportation system -- investments in pavements, bridges, public transportation, rail, aviation and ports, and a long-term focus on preserving its assets -- will help build the foundation for future economic growth of New York State. These critical decisions will impact the State’s citizens, economy, and environment for decades to come. Accordingly and appropriately, sustainability is integral in NYSDOT’s Program Update process.

As part of its programming, NYSDOT will implement creative and low-cost ways to increase multi-modal, non-polluting and less-polluting forms of transportation. In doing so, NYSDOT’s actions will
reduce waste, improve safety for all users, increase livability, implement “smart growth” principles and utilize sound environmental practices.

To ensure that NYSDOT is making good decisions, the Department identified four guiding principles to meet the needs of its customers. Each of the “Forward Four” principles -- Preservation First; System not Projects; Maximize Return on Investment; Make It Sustainable – individually emphasize a sustainable approach to consider economic competitiveness, environmental stewardship and social equity; collectively they ensure integration of sustainability into NYSDOT’s decisions and investments.

By adhering to these principles, NYSDOT strives to keep the transportation system safe and maximize the life of existing infrastructure while working to improve livability and promote economic development within the context of limited financial resources. It is important to ask the right questions and make decisions based on how to preserve existing investments and assets, how to provide the best transportation system to customers, and how to do it in a fiscally responsible manner.

Preservation First - “Sustainability Begins With Preservation”, as noted in the Whole Building Design Guide (2010) and touted by the National Trust for Historic Preservation. Accordingly, the primary focus of NYSDOT’s program update is on system preservation and safety. Such a strategy is a cost-effective approach that provides a solid foundation for a sustainable future and supports the triple bottom line of sustainability.

*Economy:* Preserving linkages to communities and businesses, and slowing or reversing the rate of infrastructure deterioration in areas that will most benefit, supports economically viable communities and makes economically sound, cost-effective and affordable decisions for now and for the future.

*Social:* Where we invest matters. A preservation strategy focuses our funds on the right treatment at the right time in the right place. The right place considers public benefits such as safety, access/proximity to emergency services, businesses, schools, modal choices as well as corridor services such as freight movement and transit.

*Environmental:* Preservation maximizes the use of existing materials and infrastructure, reduces waste and minimizes footprint.
System not Projects – Just as it is important to look at our natural landscape from an ecosystem perspective rather than individual elements, it is important to consider the transportation infrastructure as a system rather than a collection of individual projects. As noted by Aronson (1997), instead of focusing on the individual pieces, systems thinking involves a broader view, looking at larger and larger numbers of interactions. A more holistic approach to transportation decisions considers projects in the context of the larger transportation system, community network and landscape. In its decisions, NYSDOT will consider and prioritize projects in a manner that treats them as key components or critical links within the larger transportation system.

Maximize Return on Investments - Sustainable programs are structured to maximize all forms of return on investments. It all comes down to responsible decisions. Emphasis is on proper management of assets with appropriate treatments, at appropriate times, and at the appropriate locations. It is important to measure economic benefits as well as capture the non-economic benefits of a transportation project, including the affects on user costs, the environment, CO₂ emissions, and other environmental and social aspects.

Make it Sustainable - A sustainable approach to programming considers the relative and cumulative value of transportation assets as they benefit the public, economy and environment. In this way, the decision-making process looks broadly at the wider benefits of the work NYSDOT does with each Comprehensive Program:

- **Economic competitiveness**: improve efficiencies in work/business travel and freight movement; improve tourism access and inter-modal connectivity; develop investments which complement or enhance the strategic investments proposed by Regional Economic Development Councils.
- **Social equity/community**: improve accessibility for transit; recreation; education; health care; support smart growth, complete streets and livability; increase safety; weigh climate-associated risk to transportation infrastructure.
- **Environmental stewardship**: increase energy efficiency and reduce greenhouse gas emissions; reduce resource consumption; limit impacts that encroach on the environmental footprint; improve air quality.

There is the overarching need to consider sustainability, both from a program/system-wide and project level perspective.

Program Perspective for Sustainability

Preserving specific assets is important, yet it is the combination of all of these assets that establishes the system and supports future quality of life and the economy of the State. To that end, NYSDOT is developing its programs within the context of the system as a whole. Recognizing current fiscal constraints, NYSDOT is considering its investment strategies in a manner that not only continues to maximize public benefits but is affordable over the long term. Programs structured around the concept of sustainability maximize return on investment, including recognizing trade-offs between the projects that are and are not selected, and deliver a safe, efficient, balanced and environmentally sound transportation system. Sustainability concepts are overarching and used throughout the program development process.

Project Perspective for Sustainability

Sustainability concepts are also incorporated into individual projects as they are developed, and into the overall process of program selection. Additionally, specific New York State legislation has been passed (Smart Growth Infrastructure Policy and Complete Streets) that require certain considerations in project development. The substance of these bills requires NYSDOT as well as localities to fully consider the needs of their assets by non-automobile users and to maximize the utility of the currently built assets.
environment. As appropriate, NYSDOT is also considering projects in the context of the state’s energy plan and draft Climate Action Plan.

The primary focus of a sustainable Comprehensive Program is to preserve critical linkages using appropriate preservation treatments for highways and bridges. When looking at transportation infrastructure needs from an asset management perspective, it is important to consider community needs and context as well as the natural environment.

It is important to stress that preservation is more than crack-sealing and filling potholes. A sustainable transportation program should include low-cost improvements to make the road networks safer, more livable, and welcoming. When preserving and enhancing the transportation system, transportation agencies have the opportunity to design and operate the entire roadway and right of way with all users in mind - including bicyclists, public transportation vehicles and riders, and pedestrians of all ages and abilities. The same concept holds true when considering the context of the natural environment. Transportation systems should be designed to be as permeable as practicable for fish and wildlife resources, connecting terrestrial and aquatic habitats traversed by the highway system.

Even small projects can make meaningful improvements. In repaving projects, for example, an edge stripe can be shifted to create more room for cyclists and a culvert posing a barrier to fish can be replaced with a more appropriately designed culvert. Such decisions, however, must be sensitive to the context of the community and natural environmental to avoid inappropriately and indiscriminately applied practices that may be costly and unwarranted.

**GreenLITES: Initial Tools for Making Sustainability Decisions**

Sustainability is an over-arching principle. At NYSDOT, we are incorporating sustainability into our programs, projects and initiatives.

NYSDOT’s sustainability ethic has been evolving and maturing over the last 5 years, largely due to the Departments GreenLITES program. GreenLITES is primarily an internal management program for NYSDOT to measure its performance, recognize good practices, identify where it needs to improve and provide a way to demonstrate how NYSDOT is advancing sustainable practices.
NYSDOT began the GreenLITES Project Design certification program in 2008 and the program quickly expanded to be a collection of tools, metrics, and spreadsheets in design, operations, planning and regions. GreenLITES Project Design and Operations are self-certification tools that distinguish transportation projects and operations based on the extent to which they incorporate sustainable choices. McVoy, et al (2010) describe NYSDOT’s GreenLITES program evolution from its environmentally based beginnings to a more comprehensive approach in support of a sustainable society.

The GreenLITES Project Design and Operations tools work well for “operational” type decisions in the Strategic/Tactical/Operational decision-making model. However, to completely integrate sustainability into its decision-making process NYSDOT quickly realized it needed to address the larger question of “How do we select the ‘right’ sustainable projects?” This led to the development of the Project Solicitation Tool (at the “what” or tactical level) and the Regional Sustainability Assessment Table (at the “why” or strategic level).

The Draft Project Solicitation Tool is a questionnaire that helps NYSDOT, Metropolitan Planning Organizations (MPOs) and other project sponsors determine how consistent a project is with seven identified sustainability goals; this, in turn, serves as a discussion point when deciding what projects to include in long term capital infrastructure program submissions.

The Regional Sustainability Assessment Table is a tool used by NYSDOT regions to develop and assess regional long term sustainability goals from a more holistic perspective and across program areas using the triple bottom line realms of economy, environment and communities. The table provides a template to identify sustainability current states, desired future states and plans for accomplishing future states in all three sustainability realms as they relate to specific desired NYSDOT outcomes.

The suite of GreenLITES tools helps NYSDOT to better align sustainability efforts in planning, design, construction, maintenance and operations and has set the groundwork for incorporating sustainability into our programming and investment decisions.

PUTTING IT TO THE TEST - APPLYING SUSTAINABILITY DECISIONS TO PAVEMENT ASSET

It is one thing to embrace sustainability as a concept; the true test is how it is implemented. Consistent with the approaches discussed, NYSDOT is addressing sustainability in pavement management by moving decisions beyond the operational level (the “how”) to a more tactical level (the “what”) and expanding it to a strategic level (the “why”) with its proof-of-concept Public Benefit model for the pavement asset.

Operational – Specifications

NYSDOT makes sustainable operational decisions for pavement management through the establishment of specifications which allow and encourage, but do not mandate, the use of a variety of “environmentally friendly” additives and/or recycled material in its pavement applications. By not mandating the use of recycled material, the contractor is allowed to use best professional judgment that considers cost and circumstances (e.g., distance from mineral source, hauling costs, material availability). The best sustainable choices will reduce social and environmental impacts while not sacrificing performance or cost effectiveness.
NYSDOT’s most common choices are warm-mix asphalt, which reduces energy required to heat the asphalt and reduces associated toxic emissions; recycling, which reduces vehicle emissions and use of resources; and thin treatments, which results in energy and material savings.

Other choices may include recycled rubber in binder; tire shreds; reclaimed asphalt pavement (RAP); cold-in-place recycling (CIPR); hot-in-place recycling (HIPR) and heater scarification; recycled concrete aggregates (RCA); recycled glass; permeable (porous) pavements; and recycled plastics.

There are varying social, environmental and economic benefits to these treatments. Though these are sustainable operational choices, their influence is more local rather than on the overall transportation system.

**Tactical - Pavement Preservation Model**

NYSDOT has an established Pavement Preservation Model (PPM) that enables managers to make system-wide economically sustainable decisions for pavement preservation. The PPM considers pavement conditions and other criteria to prioritize project-specific locations for work over a ten-year period based on treatment selection matrix and available funding.

The cornerstone of a pavement preservation strategy is the application of lighter preventative maintenance treatments on a relatively frequent basis while the pavement is still in good condition. As a pavement ages, the asphalt oxidizes, making it more brittle and susceptible to cracking. As these cracks develop, water infiltrates through the cracks, down into the base and subbase layers. In colder climates, this water freezes and expands, and when it thaws, it leaves voids in the base and subbase, and reduces the strength of the pavement structure making it even more susceptible to more severe distress.

Preventative maintenance treatments, such as chip seals, microsurfacing, paver placed surface treatments and thin HMA overlays seal existing cracks, rejuvenate the pavement and keep surface water out of the underlying pavement layers. They are most appropriate for pavements with light to moderate distress, and if they are used on pavements with too much cracking, the service life can be significantly shortened.

Preventative maintenance treatments are relatively inexpensive, costing $30,000-$70,000 per lane-mile. If a pavement requires a moderate treatment, such as a mill and fill or cold in place recycling, the cost can run up to $135,000-$200,000 per lane-mile (four times as expensive). And if a pavement is allowed to deteriorate to the point where it needs major repairs or reconstruction, the cost can be $500,000-$1 million per lane-mile (sixteen times more expensive). Over the life of a pavement, it is more economical to apply a preventative maintenance treatment every 8 years than to reconstruct the pavement every 25 years or so.

A preservation first strategy uses far less natural resources than full reconstruction because preservation treatments are thin and do not involve replacing or re-establishing deeper layers of the pavement. Preservation treatments use less energy as they require less material to be hauled which requires fewer construction vehicles. In addition, pavements that receive frequent light treatments tend to stay smoother over their lifetimes, reducing fuel use, vehicle maintenance costs, and greenhouse gases.

NYSDOT’s PPM is used to develop future work plans and estimates future pavement conditions and improvement needs for highways in New York State. The principal strategy of the PPM is to maximize the number of vehicles traveling on good pavement at the lowest possible long term cost. The model prioritizes pavement maintenance projects based on cost/vehicle miles traveled (VMT), resulting in preservation on high priority roads. The end result is the lowest cost solution with the highest benefit to the most people.
Though applying preservation treatments is an economically sustainable “tactical” practice to keep our good pavements in good condition, this model does not consider social or environmental aspects; consequently, some low-volume roads may be at risk of suffering further deterioration. This, in turn, may have deleterious affects on land use, community cohesion and the economy. For instance, a low volume road that supports the forest product or agricultural industry may be at risk if social and environmental factors are not considered.

**Strategic – Public Benefit Model**

To explore how NYSDOT might take the pavement preservation model one step further, a team developed an add-on to consider the environmental, economic, and societal benefits of NYSDOT’s maintenance and capital work on the transportation infrastructure. The team developed a proof-of-concept sustainability model that evaluates the public benefit of the suggested program of projects from the pavement preservation model. Each project is given weighted values depending on its proximity to “landmarks” of public interest and function of the project segment in the system, such as access for emergency services, businesses, schools, inter-regional connectors, etc. The public benefit of any one project can be compared to another for project level comparisons. The weightings can also be accumulated for all the projects in a particular program to provide the public benefit of a particular mix of projects, prioritization strategy and funding level.

The second component of the benefit model is the ability to quantify the environmental benefits in terms of fuel savings and greenhouse gas (GHG) emissions from improved pavement smoothness. Multiple research studies have analyzed the relationship of pavement roughness to vehicle fuel consumption and excess user costs. These studies show that International Roughness Index (IRI) and fuel consumption have a direct relationship: the higher the roughness, the higher the fuel consumption for trucks and automobiles. Gillespie and McGhee (2007) provide an excellent synthesis of the topic in their research paper, “Get In, Get Out, Come Back! What the Relationship Between Pavement Roughness and Fuel Consumption Means for the Length of the Resurfacing Cycle”. NYSDOT used this paper as the basis for its analysis, and developed formulas that relate differences in IRI to mile per gallon for trucks and automobiles.

NYSDOT’s Public Benefit Model, which factors in social, environmental and economic sustainability facets into its pavement preservation model, has potential to equip NYSDOT to make strategic decisions on critical infrastructure improvements beyond simply economic considerations.

**MESSAGING DECISIONS – THE VALUE OF TRIPLE BOTTOM LINE LANGUAGE**

Articulating decisions using the “Triple Bottom Line” terminology of sustainability, factoring in economic, environmental and social aspects, has great potential to serve NYSDOT as it makes and justifies its decisions to the various stakeholders. For instance, the public may focus on the social issues; resource agencies and environmental advocacy groups may emphasize environmental features; and government officials may stress economics at this fiscally constrained time. Hard decisions need to be made; it is incumbent upon the agency to demonstrate that its decisions are fiscally, socially, and environmentally sound to serve the public. By showing how decisions relate to and help people and can be desirable to society, partners and stakeholders, NYSDOT may gather more support and less criticism, gaining credibility and public trust.

**CONCLUSION: SUSTAINABILITY AND ASSET MANAGEMENT**

Asset management and sustainability go hand-in-hand; it’s about making responsible decisions at all levels. Having a strong asset management framework and process in place will improve the ability to
make good strategic decisions; decisions that support the long-term goal of providing a safe and reliable transportation system for customers in a fiscally responsible and sustainable manner.

An asset management system which includes sustainability as an over-arching principle will help transportation agencies look strategically and critically at investment choices and better inform those involved in the decision-making process.

NYSDOT’s Forward Four principles -- Preservation First; System Not Projects; Maximize Return on Investment; Make It Sustainable -- will serve to guide NYSDOT as it incorporates sustainability into its decisions. Using these principles, NYSDOT is developing a holistic approach that supports responsible decisions and invest funds in a manner that not only preserves the most important assets but that best meets the needs of those who rely on the transportation system.

The anticipated outcome is a strategy and process for capital investment and resource allocations resulting in cost-effective investments to preserve and manage the multi-modal transportation assets of the state in an economically, environmentally and socially sustainable manner.

REFERENCES


NYSDOT Sustainability and GreenLITES website link: <https://www.nysdot.gov/programs/greenlites >.


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Debra Nelson is the Assistant to the Director of the 5,000 member Operations Division for NYS Department of Transportation. Deb serves on the Commissioner’s Comprehensive Asset Management/Capital Investment Team to develop an investment strategy, framework and process to preserve and manage the multimodal transportation assets. Debra is a Certified Ecologist and Professional Wetland Scientist involved in statewide and national efforts on environmental stewardship and sustainability in transportation, serving on projects of the National Cooperative Highway Research Program, Strategic Highway Research Program and National Highway Institute. She serves on the TRB Committee on Ecology and Transportation and is the Chair of the International Conference on Ecology and Transportation.

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