UNITED STATES DEPARTMENT OF TRANSPORTATION

Transportation Theme of the National Spatial Data Infrastructure

Strategic Plan 2021–2024

Version 1.1

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Contents

1 Executive Summary

The Transportation Theme of the National Spatial Data Infrastructure (NSDI), formed of National Geospatial Data Assets (NGDAs), is critical to the Nation. The U.S. Department of Transportation (USDOT) Bureau of Transportation Statistics (BTS) facilitates and coordinates the management and development of the Transportation Theme. Covered Agencies and partner agencies within the Transportation Theme community manage individual NGDAs. This strategic plan describes the activities the Department and its partners will complete to meet Transportation Theme goals and objectives.

Vision

With input from the Transportation Theme community, and in accordance with the Geospatial Data Act of 2018 (GDA), the USDOT developed this Transportation Theme Strategic Plan (TTSP) to detail the activities necessary to achieve their shared vision:

The Transportation Theme of the National Spatial Data Infrastructure enables people to access, visualize, analyze, and understand critical transportation data while driving innovation and promoting transportation safety, efficiency, economic development, and national and global connectivity.

As the lead agency for the NGDA Transportation Theme, the USDOT is responsible for writing the TTSP. Accordingly, USDOT undertook a stakeholder engagement process to ask for input and gain mutual understanding from the Transportation Theme community including USDOT Statistical, Geospatial, and Data Leadership, Covered Agency Geographic Information Officers, and NGDA Dataset Managers. The resulting 2021–2024 TTSP offers a framework for maturing and enhancing the theme in a way sensitive to technological, economic, and organizational constraints and opportunities. It updates the goals and objectives included in the 2016–2019 Transportation Theme Strategic Plan and is responsive to the Federal Geographic Data Committee's NSDI Strategic Plan 2021–2024 (November 2020).

Strategic Goals and Objectives

Goal 1: Implement Federal Geospatial Policies and Governance Framework.

Goal 2: Mature the Transportation Theme through expanded data sources and accelerated data acquisition.

Goal 3: Advance open standards-based interoperability among the Transportation Theme community.

Goal 4: Enable and promote collaborative governance and partnerships to meet transportation theme needs, priorities, and circumstances.

Additionally, the plan documents the challenges and opportunities dataset managers foresee in the next three years, including the steps that USDOT and its partners will take collectively to achieve their stated goals. The quality of the Transportation Theme hinges on efforts to improve the completeness, accuracy, and accessibility of spatial data across all travel modes in the transportation network.

2 Introduction

The National Spatial Data Infrastructure (NSDI) is managed according to the policies defined in the Geospatial Data Act of 2018 (GDA). The GDA defines the NSDI as the "technology, policies, criteria, standards, and employees necessary to promote geospatial data sharing throughout the Federal Government, State, tribal, and local governments, and the private sector (including nonprofit organizations and institutions of higher education)." Since its establishment in the early 1990s, the NSDI has become a critical vehicle for easing seamless data development, information sharing, and collaborative decision-making across multiple levels of the government.

The GDA codifies the committees, processes, and tools used to develop, drive, and manage the NSDI. It reflects growing recognition of the essential value of geospatial data and technology in understanding and managing the world and highlights the need to support their continuing development as critical investments for the Nation. Specifically, the GDA formalizes governance processes related to geospatial data, provides policy and guidance to empower the use of geospatial data and technology, and eases broad cooperation between the public and private sector. The GDA also codified the duties and responsibilities of lead covered agencies[1] (LCA) and covered agencies[2] (CA). The Transportation Theme community will continue to implement national geospatial policies and governance frameworks defined by the GDA and other governing documents.

As the LCA for the National Geospatial Data Asset (NGDA) Transportation Theme, the USDOT is responsible for writing the TTSP.[3] Accordingly, USDOT engaged stakeholders, including USDOT Statistical, Geospatial, and Data Leadership, CA Geographic Information Officers, and NGDA Dataset Managers, to ask for input and gain buy-in. The resulting 2021–2024 TTSP offers a framework for maturing and enhancing the theme in a way sensitive to technological, economic, and organizational constraints and opportunities. It updates the goals and objectives included in the 2016–2019 Transportation Theme Strategic Plan and is responsive to the Federal Geographic Data Committee's (FGDC) NSDI Strategic Plan 2021–2024 (November 2020).

3 Vision

The NSDI Strategic Plan for 2021–2024 defined the overall vision for the NGDA to be:

Empowering a geo-enabled Nation and world for place-based decision-making.

Complementing this aspiration, the USDOT, in coordination with dataset managers, developed the following vision statement for the Transportation Theme:

[1] Lead Covered Agencies ensure the coordinated management of the data, supporting resources (including technology and personnel), and related services and products of the NGDA data theme.
[2] A Covered Agency is an executive department, as defined in section 101 of title 5 that collects, produces, acquires, maintains, distributes, uses, or preserves geospatial data on paper or in electronic form to fulfill the mission of the Executive department, either directly or through a relationship with another organization, including a State, local government, Indian tribe, institution of higher education, business partner or contractor of the Federal Government, and the public.
[3] 43 USC Ch. 46, §2805.b.3

The Transportation Theme of the NSDI enables people to access, visualize, analyze, and understand critical transportation data while driving innovation and promoting transportation safety, efficiency, economic development, and national and global connectivity.

Transportation stakeholders rely on the Transportation Theme community to maximize the benefit of geospatial-transportation data by defining data management best practices to reduce inefficiencies, fostering standardization to ease information access and exchange, and advocating for adequate resourcing to ensure efficacy. Practitioners use Transportation Theme data to model the locations, interconnectedness, and characteristics of the all modes of transport moving goods and people nationwide. View the Transportation Theme's vision through this lens.

Guiding Principles for the Transportation Theme

Agencies collecting, producing, maintaining, using, and publishing geospatial data recognize the dynamic nature of the transportation network and its characteristics. Consequently, Transportation Theme dataset managers continually evaluate and revise their data management processes. A guiding principle of the Transportation Theme is collaboration. The Theme partners with federal, state, local, and tribal governments, institutions of higher education, and private sector entities through many professional organizations, boards, committees, working groups, and initiatives to identify, analyze, and develop community sanctioned data management policies to help ensure its promise. Examples of the organizations, boards, and committees engaged include:

Figure 1 – OMB Circular A-16 Supplemental Guidance
Lifecycle stages for developing & managing geospatial datasets

- USODT Geospatial User Group
- FAA Geospatial Community of Practice
- FGDC Geospatial Data Act Working Group
- FGDC Geospatial Transportation Subcommittee
- Work Zone Data Working Group
- US Roads Specification Working Group
- Federal Land Roads Working Group
- Federal Trails Working Group
- Intercity Bus Working Group
- Open Street Map Government Committee
- Theme Updates to the USDOT Chief and Deputy GIO

- National States Geographic Information Council
- American Association of States Highway and Transportation Officials
- Transportation Research Board
- GIS-Transportation Conference
- ESRI's Federal Users Conference
- ESRI's International Users Conference
- Rural and Intercity Bus Conference

Theme Collaborations and Utilization

Internally, the USDOT relies on the Transportation Theme community to help inform legislative, and departmental leadership, lead the development of geospatial data management best practices, foster standards development, and facilitate regulatory compliance. Specifically, the Bureau of Transportation Statistics (BTS) often collaborates with USDOT Operating Administrations (OA) to provide spatial analysis and cartographic products, which rely on transportation NGDAs, to inform Congress, the Secretary, Deputy Secretaries, and Administrators about various subjects and events. The Department's Transportation Operations Center (TOC) exemplifies how the Transportation Theme collaborates to serve the Public, the Department, and National Leadership. The TOC supports Departmental and National leadership by monitoring the Nation's Transportation Network. The TOC activates the Department's geospatial cadre in the event of regional or national emergencies. The cadre provides cartographic and geospatial analysis help which is essential in establishing and maintaining situational and spatial awareness. The cadre relies on the Department's Spatial Data Infrastructure to deliver this essential service.

USDOT's Geospatial Management Office (GMO), Transportation Theme Lead, and Geospatial Data Administrators lead, take part in, and make meaningful contributions to the FGDC's committees and working groups that define national geospatial management policies and best practices. The Geospatial Transportation Subcommittee (GTS) Chair, working closely with the Intelligent Transportation Systems-Joint Programs Office, fostered the adoption of GeoJSON[4] as the geospatial standard used by the Work Zone Data Working Group[5] (WZDWG). The WZDWG consists of representatives from federal, state, local, educational, and private industry communities.

USDOT also works with multiple Federal departments and agencies to collect, compile, analyze, publish, maintain, and archive geospatial-transportation datasets, including Theme NGDAs. Federal partners also collaborate on defining data management strategies and best practices. The development of this Strategic Plan relied significantly on contributions from the Census Bureau, Federal Aviation

[4] GeoJSON is a geospatial data interchange format based on JavaScript Object Notation (JSON). It defines several types of JSON objects and how to combine them to represent data about geographic features, their properties, and their spatial extents. The WZDWG's adoption of the GeoJSON specification eases the collection, publication, visualization, and exchange of geospatial work zone, and other road event data, as geospatial features across the transportation industry.

[5] The WZDWG, established in 2019 under the FGDC GTS, maintains the Work Zone Data Exchange Specification with the goal of publishing incremental updates to refine the features, attributes, and vocabulary needed to model data on work zone activity.

Administration, FGDC, Federal Highway Administration, Federal Rail Administration, Federal Transit Administration, US Army Corps of Engineers, USDOT GMO, and the Volpe Center. The continued and enthusiastic support of the same organizations ensures the successful implementation and administration of this plan.

State partners provide data for the Bridge NGDA and are involved in defining the U.S. Road Specification. Local partners, like Metropolitan Planning Organizations, use transit, bus, and intermodal data to understand the extent and connectivity of their passenger networks. Private partners, such as the intercity bus industry, use bus and intermodal passenger data to find the most advantageous locations for stops.

The GMO and BTS rely on data access statistics to measure the value of geospatial-transportation data. BTS publishes several NGDA map services on a GMO managed server. Map services provide access to geospatial data and services via an internet transfer protocol known as REST (Representational State Transfer). BTS customers access the data, via the REST protocol, for various geospatial needs. The GMO tracks access to the NGDA map services and gives data access statistics to BTS in a weekly report. BTS uses the weekly report to better understand performance, identify problems, assess community needs, and resource planning. NGDA datasets account for about 175,000 server transactions per week, or about 41% of all BTS' map service transactions.

Another measure is the frequency with which research articles reference BTS' National Transportation Atlas Database (NTAD). According to Google Scholar,[6] published research articles referenced NTAD, which offers most transportation NGDAs, 135 times between 2016 and 2020. A standard Google search for the phrases "National Transportation Atlas Database" and "University", and excluding the phrase "Bureau of Transportation Statistics", returned 32,000 hits.[7]

There is no doubt; the community is using the data. The GMO and BTS continue to monitor the industry for trends while techniques for geospatial data valuation emerge. As trends evolve into best practices, the GMO and BTS will introduce improved valuation methods and improve its management of the theme.

Desired State of the Transportation Theme

- Be the authoritative source of the highest quality, most accurate, complete, and current spatial and attribute data for the transportation network;
- Use performance metrics to measure improvements and better describe success;
- Lead collaboration and cooperation to improve geospatial data standards;
- Provide the public with access to state-of-the-art, interactive visualization tools for the

[6] Google Scholar is a search engine designed to find and rank relevant research articles from many disciplines and sources. The following search term was used to find articles which referenced the National Transportation Atlas Database which offers most transportation NGDAs: https://scholar.google.com/scholar?q=%22National+Transportation+Atlas+Database%22&hl=en&as_sdt=0%2C9&as_ylo=2016&as_yhi=2020

[7] Google Search Terms: "National Transportation Atlas Database" AND "University" - "Bureau of Transportation Statistics"

Transportation-NGDAs;

- Use innovative technologies for better access to real-time data to improve status monitoring, situational awareness, decision-making, and event control.
- Explore opportunities for enhancing spatial transportation data through crowd-sourcing and ingesting shared services provided by external stakeholders;
- Share knowledge and best practices on the application of advanced technologies among practitioners in the transportation community;
- Seek occasion to ensure financial stewardship by reducing geospatial costs and enhancing resource allocation, including identifying duplication in dataset management activities.

4 Current State of the Transportation Theme

The NSDI consists of eighteen (18) NGDA Themes managed by twenty-five (25) Federal agencies. Each theme includes a group of data layers the FGDC's Steering Committee has designated as being National Geospatial Data Assets. The USDOT, as the LCA for Transportation, administers the Transportation Theme, which consists of fifteen (15) NGDAs (Table 1). The theme partners with five (5) covered agencies and the US Army Corps of Engineers (USACE) to manage the datasets. The USACE, as an agency of the Department of Defense, is exempt from GDA responsibilities.[8]

Transportation Theme's NGDAs

Responsible Covered Agency	Transportation NGDAs
Department of Commerce - Bureau of the Census	Roads - TIGER/Line Shapefile
Department of Defense - U.S. Army Corps of Engineers (USACE)	Ports
	Waterway Locks
	Inland Electronic Navigational Charts
	Navigable Waterway Routes
	Navigable Waterway Nodes
USDOT - Federal Aviation Administration (FAA)	Airports
	Runways
USDOT - Bureau of Transportation Statistics (BTS)	Transit Stations
	Transit Lines
	Intermodal Freight Facilities
	Intermodal Passenger Facilities
USDOT - Federal Railroad Administration (FRA)	Rail Nodes
	Rail Lines
USDOT - Federal Highway Administration (FHWA)	National Bridge Inventory

Table 1. Transportation NGDAs and Responsible Covered Agencies

Roles and Responsibilities Related to the Transportation Theme

The FGDC, as the lead entity in the executive branch responsible for the development of geospatial data, identified the following roles and responsibilities (Table 2) necessary for the successful management of NGDA Themes.

[8] 43 USC Ch. 46, §2801.3.B

Theme Role	Who	Responsibilities
Lead Covered Agency	USDOT is the Lead Covered Agency for the Transportation Theme	• Leads coordination of a NGDA Theme • Works with partners to develop, manage, and maintain datasets associated with the Theme • Advocate funding recommendations • Provide Executive NGDA Theme Champion • Appoint NGDA Theme Lead • Designate and/or work with Dataset Manager
Executive Champion	The Chief Data Officer is the USDOT's Executive Champion. NGDA Executive Champions	• Advocates for, raises awareness of, and promotes the implementation of a NGDA Theme and its NGDA Datasets • Provides high-level sponsorship, visibility, and support for the NGDA Theme • Advises the SAOGI • Intervenes as necessary to ease communication among high-level stakeholders
Senior Agency Official for Geospatial Information (SAOGI)	USDOT Chief Geospatial Information Officer is the Department's SAOGI Agency SAOGIs who also serve as FGDC Steering Committee Members	• Has agency-wide responsibility, accountability, and authority for geospatial information issues • Oversee, coordinate, and facilitate the agency's implementation of the geospatial-related requirements, policies, and activities • Appoints FGDC Coordination Group members
Theme Lead	The Bureau of Transportation Statistics (BTS) provides the Department's Theme Lead. NGDA Theme Leads	• Serves as "Master Coordinator" • Coordinates and oversees NGDA Theme strategic planning and implementation • Manages annual reporting process • Develops funding recommendations • Working with FGDC CG, identifies dataset development priorities • Chairs the corresponding Thematic Subcommittee • Engages Federal and non-Federal stakeholders • Oversees nomination/removal of NGDA Datasets • Oversees Dataset Managers • Manages Theme Community on GeoPlatform.gov
Dataset Manager	Theme Dataset Managers include personnel from the BTS, Census, FAA, FHWA, FRA, and USACE.	• Evaluates NGDA Dataset against the Geospatial Data Lifecycle • Submits Annual NGDA Dataset Report to the NGDA Theme Lead • Works with Data Stewards, Stakeholders, and/or Community of Interest • Manages Dataset Information on Data.gov/GeoPlatform.gov • Assist with incorporation of funding information into a comprehensive annual NGDA Theme Report
FGDC Coordination Group Members	Representatives from Federal agencies and FGDC recognized stakeholder groups, chairpersons of the thematic Subcommittees and 'cross-cut' Working Groups	• Advances the development and maintenance of the NSDI, and associated coordination of Federal programs through collaboration and consensus of its member representatives • Communicates FGDC actions and activities to SAOGIs and other appropriate entities within their respective agencies • Works with the SAOGI and agency management to align the appropriate support to develop and sustain the NSDI and datasets for which they have responsibility under OMB Circular A-16

Table 2. Theme Roles and Responsibilities

5 Goals and Objectives

The Transportation Theme Strategic Plan aligns with the four strategic goals the FGDC collaboratively developed for the NSDI Strategic Plan 2021–2024 and assigns objectives and action items to focus efforts on achieving those goals. This section describes these elements, as well as outcomes anticipated after implementation.

NSDI Strategic Goal	Theme Strategic Goals
Implement the national geospatial policy and governance framework as defined by the GDA and related statutes and policies.	Implement Federal Geospatial Policies and Governance Framework
Advance the maturity of, accelerate the acquisition of, and expand the sources of NGDAs to ensure that they are findable, accessible, interoperable, and reusable.	Mature the Transportation Theme through expanded data sources and accelerated data acquisition
Ensure open standards-based interoperability to enable geospatial shared services.	Advance open standards-based interoperability among the Transportation Theme community
Enable and promote collaborative governance and partnerships to meet national needs, priorities, and circumstances.	Enable and promote collaborative governance and partnerships to meet transportation theme needs, priorities, and circumstances.

Table 3. Mapping NSDI Strategic Goals to Theme Strategic Goals

Goal 1: Implement Federal Geospatial Policies and Governance Framework

Implementing federal geospatial policies and governance frameworks defined in the GDA, and related statutes and policies, coordinates the USDOT's efforts with its federal, state, local, tribal, educational, and private industry partners. Focusing the community's efforts towards improving geospatial data management practices both nationally, and within the USDOT, fosters efficiency and innovation through improved governance, better data integration, effective resource management, focused workforce development, and expanded partnerships and markets.

Objective 1.1. Administer the Transportation Theme According to the GDA

Administer the Transportation Theme according to the GDA by leading and facilitating the nationwide population of the Transportation Theme[9] and by coordinating the management of data, supporting resources, and related services and products of the theme.[10]

Anticipated Outcomes. Improved governance, expanded partnerships, sufficient resourcing, work force development, better data integration, expanded markets, and an environment that fosters innovation.

Action 1.1.1. Establish goals that support the strategic plan for the NSDI prepared under 43 USC Ch. 46, §2804(c) of the GDA.[11]

Action 1.1.2. Expedite the maturation of the Transportation Theme by through the effective implementation of theme strategies.[12]

[9] 43 USC Ch. 46, §2805.b.3.C,
[10] 43 USC Ch. 46, §2805.b.2 and §2801.b.3.E
[11] 43 USC Ch. 46, §2805.b.3.C
[12] 43 USC Ch. 46, §2805.b.3.B.v

Action 1.1.3. Address the human and financial resource needs of the Transportation Theme. [13] Human and financial resource needs shall be addressed as needed. At a minimum, they shall occur every three years and coincide with Transportation Theme Strategic Plan updates. Addressing the human and financial resource needs shall estimate the cost of administering the Transportation Theme and collect qualitative performance indicators for partner programs. Performance indicators shall estimate future performance of partner programs by evaluating their past performance. If needed, geospatial data management practices will be adjusted to facilitate the continued delivery of NGDAs and related services. Appendix 10.8 details how the theme addresses human and financial resource needs.

Action 1.1.4. Identify needs relating to standards, metadata for geospatial data, and the GeoPlatform.[14]

Action 1.1.5. The Transportation Theme will aid the Department's Geospatial Management Office in developing the USDOT GIS Strategic Plan[15]. The GMO, acting as the CA, defines the actions the Department will take to successfully meet the responsibilities defined in section 2808 of the GDA (Appendix 5).[16]

Action 1.1.6. Submit a performance report to the FGDC, at least annually, that documents the activities relating to and implementation of the NGDA data theme, including progress in achieving the requirements.[17]

Action 1.1.7. Respond to comments from the FGDC, as appropriate, regarding the summary and evaluation of the performance report.[18]

Goal 2: Mature the Transportation Theme Through Expanded Data Sources and Accelerated Data Acquisition.

A mature theme maximizes the benefit of geospatial-transportation data by ensuring the public can find, access, integrate, and examine it. The USDOT will continue to mature the Transportation Theme through persistent and thorough examinations of content and management practices. Specifically, the Department will develop or adopt data content standards to foster the exchange and integration of data. Further, the Department will perform scheduled examinations of data gaps, source gaps, data collection processes, and best practices.

[13] 43 USC Ch. 46, §2805.b.3.B.iii
[14] 43 USC Ch. 46, §2805.b.3.B.iv
[15] The USDOT GIS Strategic Plan is equivalent to the FGDC's Covered Agency Geospatial Strategy (CAGS)
[16] 43 USC Ch. 46, §2808.a.1
[17] 43 USC Ch. 46, §2805.b.3.E.ii.I
[18] 43 USC Ch. 46, §2805.b.3.E.ii.II

Objective 2.1. Lead and facilitate the development, or adoption, and implementation of geospatial data standards for the Transportation Theme, with an emphasis on data content standards.[19]

Anticipated Outcomes. Improved governance, better data integration, and an environment that fosters innovation.

Action 2.1.1. Recognizing the NGDAs development continuum, the USDOT will establish a Geospatial Standards Implementation Plan[20] (GSIP) consistent with the NSDI. This action, which will ease the seamless integration of future datasets, will rely on the input of NGDA dataset managers and other transportation stakeholders.

Action 2.1.2. The GSIP shall assess existing standards,[21] identify anticipated or needed standards,[22] and detail a process to originate and implement needed standards with relevant community and international practices.[23] The standards development, or adoption, processes will comply with OMB Circular A–119,[24] or any successor.[25]

Action 2.1.3. Develop procedures to assess annually data gaps, source gaps, data collection processes, data integration processes, and best practice.

Goal 3: Promote open standards-based interoperability to enable geospatial shared services.

Shared services are web-accessible, standards-based tools, applications, and services that enable the discovery, access, integration, and application of geospatial data. They offer an all-inclusive collaborative environment for improved decision-making.

The GMO runs a shared services environment for the Department. Various OAs and the Office of the Secretary of Transportation (OST) publish their geospatial data to a server[26], within the shared services environment, according to the Representational State Transfer (REST) specification. The consumption and integration of the geospatial data is effortless because they are compliant with the same REST specification. For example, BTS can quickly map fatal crash data, offered from the Federal Motor Carrier Safety Administration (FMCSA), with road segments, offered by the Federal Highway Administration, and Bus Stops, offered by BTS, by simply giving the web addresses of each dataset. Similarly, the various OAs and OST publish maps, applications, and geoprocessing services to a portal,[27] within the shared

[19] 43 USC Ch. 46, §2805.b.3.A
[20] 43 USC Ch. 46, §2805.b.3.A.iii.II
[21] 43 USC Ch. 46, §2805.b.3.A.i
[22] 43 USC Ch. 46, §2805.b.3.A.ii
[23] 43 USC Ch. 46, §2805.b.3.A.iii
[24] OMB Circular A–119 (February 10, 1998) establishes policies on Federal use and development of voluntary consensus standards and on conformity assessment activities.
[25] 43 USC Ch. 46, §2805.b.3.A.iii.I
[26] USDOT Data Server
[27] USDOT Portal

services environment, according to the REST specification. Publishing rest compliant data and services enables quick and easy sharing of maps, applications, and analysis among the community and with the public.

The GeoPlatform, a shared services environment for the Nation, enables sharing and integrating data and services at an international scale. Promoting and fostering the GeoPlatform will increase the need for, accelerate the development of, and expand the use of, geospatial-transportation data.

Objective 3.1. Coordinate with, and foster the use of, the GeoPlatform to increase the need for, accelerate the development of, and expand the use of, geospatial-transportation data.[28]

Anticipated Outcomes. Improved governance, expanded partnerships, better data access, integration, and analysis, expanded markets, and innovation, greater adoption standards, services, and systems, awareness of data, information, and resources available through the Transportation Theme; increased use of shared services; reduced duplication of effort.

Action 3.1.1. Designate a point of contact within the LCA who shall be responsible for developing, maintaining, coordination relating to, and disseminating data using the GeoPlatform, as well as related coordination.[29]

Action 3.1.2. Encourage individuals and entities that are a source of geospatial data or metadata for geospatial data for the Transportation Theme to provide access to such data through the GeoPlatform.[30]

Goal 4: Enable and promote collaborative partnerships to meet national needs and priorities for geospatial transportation data.

The USDOT is in a unique position to provide leadership and facilitation in the geospatial transportation community. These roles include fostering collaboration across sectors to promote communication and knowledge exchange about the use and benefits of geospatial data, technology, and the NSDI. This goal describes how the Transportation Theme community can collaborate to use geospatial data, assets, technologies, communications approaches, and services to advance the theme and meet the goals and requirements of the GDA.

Objective 4.1. Meet the needs of users of Transportation Theme data.[31]

Anticipated Outcomes. A well-connected community; Geospatial-transportation awareness; formalized needs assessments; improved documentation; increased use of geospatial-transportation data, applications, and analysis.

Action 4.1.1. Develop partnership programs with States, Indian tribes, institutions of higher education, the private sector, other Federal agencies, and local governments by creating and taking part in

[28] 43 USC Ch. 46, §2805.b.3.E.iv, §2805.b.3.E.v
[29] 43 USC Ch. 46, §2805.b.3.E.i
[30] 43 USC Ch. 46, §2805.b.3.E.iv
[31] 43 USC Ch. 46, §2805.b.3.B.ii

communities of practice (E.g., the FGDC, Geospatial Transportation Subcommittee, Transportation Research Board, American Association of State Highway Officials (AASHTO), National States Geographic Information Council (NSGIC)) and other professional groups to foster geospatial transportation awareness.[32]

Action 4.1.2. Leverage partnership programs to solicit input on the need and use of transportation data and services.[33]

Action 4.1.3. As necessary, collect and analyze information from users of geospatial data within the Transportation Theme about the needs of the users for geospatial data and incorporate the needs of users in strategies relating to the Transportation Theme.[34]

Action 4.1.4. Identify and publish proven practices for the use and application of geospatial data of the LCA.[35]

Action 4.1.5. Publish maps or comparable graphics online (following the mapping conventions specified by the FGDC) showing the extent and status of the NGDA data themes for which the CA is an LCA.[36]

6 Implementation

The TTSP provides a shared vision for the development of the Transportation Theme designed for application by USDOT agencies, partners, and stakeholders throughout the geospatial-transportation community. A broad range of stakeholders will participate in activities to implement TTSP goals and objectives. The Transportation Theme will work closely with its federal, state, local, tribal, university, college, and private sector partners to ensure broad engagement of the geospatial-transportation community to promote collaborative approaches to advance the critical geospatial infrastructure.

The FGDC designated the USDOT as the LCA responsible for ensuring the coordinated management of the data, supporting resources (including technology and personnel), and related services and products of the Transportation Theme. The USDOT also serves as a catalyst for implementing the TTSP. Designated Federal representatives will serve as champions for the advancement of specific strategic goals. Champions will report to the USDOT, and will coordinate teams consisting of representatives from across the geospatial-transportation community as they implement actions that advance strategic plan goals and objectives.

Successful implementation of the goals and objectives in this plan will align with the requirements of the GDA, the Federal Data Strategy, the Foundations for Evidence-Based Policymaking Act, and OMB Circular A-16. This will require senior policy-level leadership to ensure appropriate resources and support for the Transportation Theme.

[32] 43 USC Ch. 46, §2805.b.3.B.i
[33] 43 USC Ch. 46, §2805.b.3.B.ii
[34] 43 USC Ch. 46, §2805.b.3.D
[35] 43 USC Ch. 46, §2805.b.3.E.vi
[36] 43 USC Ch. 46, §2805.b.3.E.iii

Planning and Reporting

The Transportation Theme Lead will develop a Theme Implementation Plan (TIP) to clarify when and how the relevant parties will accomplish the actions listed above. Further, the TIP will define procedures to assess data, administration, resource, and workforce needs. The Department's Geospatial Management Office has published a 2021-2024 GIS Strategic Plan which defines the goals, objectives, and actions the Department will take to meet GDA requirements and support the NSDI. Theme and covered agency implementation activities are a key component of the overall TTSP monitoring and reporting process. The TIP and DOT GIS Strategic Plan include milestones, timelines, responsible parties, performance metrics, identification of available resources, and reporting processes.

Measuring Progress

As required by the GDA, the Department will assess and report progress against the TIP and DOT GIS Strategic Plan quarterly and yearly. The Theme lead will complete the theme performance report. The Department's Geospatial Management Office will complete annual Covered Agency Report to the FGDC and will participate in OIG's biennial audit of GDA compliance. After USDOT approval, the Theme Lead will forward the Theme performance report to the FGDC. The GMO has informed the FGDC that it has posted the 2021-2024 DOT GIS Strategic Plan. The FGDC will compile the theme reports and provide them to the National Geospatial Advisory Committee (NGAC) and Congress. The GMO and Theme Lead will coordinate responses to all NGAC and Congressional inquiries resulting from the reports.

The performance measurement approach is critical to the successful implementation of the goals and objectives described in this plan. Performance metrics are quantifiable and will describe whether the identified action is achieving its expected result and if there is progress toward reaching the requirement or objective.

The FGDC, as the lead coordinating agency, will assist in identifying resources as well as developing tracking and reporting tools for all LCAs and CAs in the NSDI. Theme champions, in collaboration with the FGDC, will monitor implementation performance based on established indicators and milestones through tracking tools. The Department will report progress towards each objective regularly. The Department will provide progress reports to the FGDC Steering Committee as needed. The Theme Lead will complete plan updates and adjustments as needed.

Initial Milestones and Deliverables

TTSP and Covered Agency Geospatial Strategy Implementation	
Timeframe	**Activity**
Oct 2020	NSDI strategic plan approval and publication
Mar 2021	FGDC Theme Annual Progress Report
Mar 2021	DOT GIS Strategic Plan Publication
Apr 2021	Transportation Theme Strategic Plan Approval
May 2021	Theme Implementation Plan Approval
Jun 2021	Assessments Plans: Cost, Resources, Workforce, Practices, Data, Services, Applications
Dec 2021	GSDP

7 Summary Impacts

A strategic plan is only effective if it has a strong implementation approach focused on achieving defined outcomes. An effective strategy should engage those whose mission will achieve the vision. The goals and objectives in this plan will mobilize the transportation geospatial community toward achieving the following results:

Improved governance

Establishing a strategic plan reflects a commitment to clarify responsibilities and objectives for improved effectiveness. This plan sets forth a foundation for governance that balances needs, such as those related to standards development, with resources available. It also promotes an open environment for discussion and decisions necessary to achieve the stated objectives. Each goal has defined objectives and trackable action items that describe what the department, and its partners, will do to meet the directives enumerated in the GDA. The plan, combined with the TIP, yearly assessments, and audits by the Office of the Inspector General, will hold the LCAs and CAs accountable.

Expanded partnerships

Geospatial-data administrators understand that collaboration is integral to success. Partnerships promote a shared understanding of the geospatial-transportation landscape and of effective geospatial data management methods. These methods ease data discovery, collection, compilation, publication, and analysis. Common methods also advance data quality and reliability by establishing an expected level of service among the community. Data providers exposed to best practices alter their approach to meet community standards.

Sufficient resourcing

Resources include money, people, and time. Determining the appropriate levels of support relies on an accurate analysis of available and required resources. Thorough accountability across a carefully self-governed community, with prudent oversight and guidance, will help focus attention on the existing distribution of resources, expose gaps for prioritized geospatial data components, and suggest budgetary realignments to address funding, people, and time shortfalls. Actions under Objective 1.1, and expanded in Appendix 7, entail estimating the cost of administering and implementing the Transportation Theme by June yearly. The estimates ensure sufficient resources are allocated and available.

Better integration of datasets

Despite features and events being inherently spatial, many do not describe them as such. Knowledge building and decision-making about things or events that influence location, or vice-versa, require timely and relevant data and information from a variety of sources. Practitioners have struggled with the complexity of integrating different sources, quality, and formats of geospatial data for years. However, newly available tools and capabilities increasingly foster data integration across disciplines. This strategic plan not only addresses the need for geospatial standards and interoperability, but also recognizes the more complex task of integration with other categories of data.

The advent of connected and automated vehicles (CAV) will revolutionize transportation by reducing personal injury and death, property damage, emissions, and increasing efficiency. CAV technology will also connect vehicles to other vehicles, infrastructure, and countless information networks. The infrastructure needed to support CAVs will rely on highly accurate, complete, and up-to-date geospatial and tabular data. The integration of data needed to support CAV technologies will rely on data standardization. The USDOT Geospatial Transportation Subcommittee's WZDWG, which the FGDC sponsors, authors a specification enabling the efficient exchange of work zone locations between data providers, such as state or local DOTs, and data consumers such as wayfinding applications. In another example, USDOT's BTS participates in the North American Transportation Statistical Interchange to integrate transportation network data across national boundaries to create a complete geospatial dataset for the continent's transportation system. Similarly, FHWA participates in national symposium to define approaches for connecting roadway spatial data across county and state lines.

Preparation of the workforce pipeline

People are a critical part of the resource equation. Therefore, the Department will ensure a vibrant workforce pipeline through education and training. Although past practice may be a prelude to some traditional earth science training in specific domains, it must also be subject to the evolution of intersecting disciplines. During the execution of this strategic plan, USDOT will direct more of its focus toward understanding whether the current workforce has the sufficient skillsets, as well as to geospatial and interdisciplinary information management. Under Objective 4.1 for example, USDOT commits to develop partnership programs with institutions of higher education, among others. Such partnerships can ensure that the variable skills the community demands – from basic data collection and labeling to more advanced machine learning and artificial intelligence innovation – draw from a broad spectrum of applications. The Transportation Theme Lead will facilitate a yearly workforce assessment that identifies needed skills and discuss how to develop them.

Expanded markets

The past decade has seen the "democratization" of the collection and use of geospatial data. Many have joined the ranks of "citizen scientists." The use of computer-generated, crowd-sourced maps and data, such as those available via OpenStreetMap or Waze, is common. Similar maps have helped urban planners decide where to best encourage growth, permitted first responders to alleviate the effects of natural disasters more quickly than ever before, and shown where ecological damage and/or restoration is occurring. The availability of massive reliable stores of geospatial data will continue to make expansion of services possible and open new markets for these data.

CAV technologies will increase the demand for geospatial-transportation data. Highly accurate road and infrastructure data are obvious needs for connected and automated vehicles. Less obvious is the need for contextual data like dangerous weather conditions, local road rules, or nearby automotive services.

It is difficult to predict where geospatial data markets will emerge. The Department benefits the public best by creating an environment that nurtures the growth of new markets through the development of data standards. The USDOT will play a key role in helping these markets work well.

Innovation

To meet the known current needs of the Transportation Theme and to satisfy the goals identified in this plan, creative thinking needs to accompany the widespread use of geospatial information. Creativity can introduce innovation in tools and techniques that will not only improve the understanding of geospatial information but will also direct its incorporation into new venues.

This plan commits the USDOT to being a global leader that drives innovation related to the Transportation Theme and, consequently, aims to promote open standards-based interoperability to streamline geospatial shared services. USDOT will also engage the stakeholder community to share and encourage innovative practices. Both should help keep the Transportation Theme as relevant as ever in the rapidly evolving transportation data collection, visualization, and presentation ecosystem.

International influence and cooperation

Both the vision and the mission of the NSDI link our national interests with our global responsibilities. The Integrated Geospatial Information Framework (IGIF) that the United Nation's Committee of Experts on Global Geospatial Information Management (UN-GGIM) has adopted guides the goals in this plan. The IGIF "provides a basis and guide for developing, integrating, strengthening, and maximizing geospatial information management and related resources in all countries. It will assist countries in bridging the geospatial digital divide, secure socio-economic prosperity, and to leave no one behind".[37]

8 Challenges and Opportunities

The Transportation Theme of the NGDA faces challenges as the LCA and CAs carry out this strategic plan. For example, the GDA places more responsibilities on the USDOT but does not provide more funding. In addition, there is an opportunity to help shape USDOT into a more "geospatial-centric" organization, whereby decision-makers can better appreciate and estimate the value of geospatial data and the resources needed to develop and maintain them. Fulfilling more mandates, with the same level of resources, in a Department whose primary mission is not geospatial data management, will require creative administration.

USDOT leadership have the difficult task of allocating limited resources among competing programs. Geospatial leadership will continue advocating for more resources. Sound cost and resource assessments will provide evidence to support their assertions. The geospatial transportation community must also investigate less expensive methods of data discovery, collection, compilation, and maintenance. Cutting cost where possible will allow geospatial leadership to shift resources towards critical tasks, but additional resources must complement such savings.

Additionally, the Transportation Theme aggregates several NGDAs from authoritative sources. This presents more than one challenge. First, the concept of "authoritative", as it relates to data, may limit the sources of geospatial data the Federal government is willing to use. Without reexamining the term's

[37] United Nations Statistics Division, 2020b, Integrated Geospatial Information Framework (IGIF)—Overview: United Nations Statistics Division web page, accessed October 6, 2020, at http://ggim.un.org/IGIF/.

definition, the USDOT and dataset managers are at risk of "being left behind" given the speed at which other stakeholders generate accurate and complete transportation data.

Furthermore, some of the Transportation Theme NGDAs (e.g., All Roads Dataset and Bridge Inventory Dataset) comprise statewide datasets that many sources provide, and thus it is difficult to control the quality, accuracy, completeness, development, and management practices of the component data.

Finally, select Transportation Theme NGDAs are old. Dataset Managers do not always have adequate funding or staffing to keep the datasets current.

To address these challenges, USDOT will first continue to build and cultivate strong partnerships with Transportation Theme dataset managers. This will include coordinating an effort among agencies to communicate to others within their respective organizations how the Theme's geospatial data is, will, and might be used. Such expanded outreach will ensure dataset consumers are aware of the Transportation Theme's role in the greater geospatial infrastructure, and more specifically that the Transportation Theme is an authoritative source of transportation data. USDOT will also facilitate discussions with dataset managers to identify existing and potential alternative funding mechanisms to ensure all Transportation Theme datasets are up-to-date. Externally, USDOT will reach out to non-traditional providers of transportation data, such as the National Park Service and the Forest Service, to identify opportunities for collaboration regarding the Transportation Theme.

One example activity is the involvement of USDOT's BTS with the North American Transportation Statistical Interchange, a group working to integrate transportation network data across national boundaries to create a complete geospatial dataset for the continent's transportation system. In another example, FHWA has convened a national symposium to delineate methods for connecting spatial data for roadways across county and state lines. Similarly, although not USDOT, the Bureau of the Census has a memorandum of understanding with the United States Geological Survey to collaborate and align areas of overlap as closely as possible. This partnership reflects itself in updates to the TIGER Roads dataset and the use of TIGER Roads in the National Map. These and other collaborative partnerships ensure that practitioners can adapt the Transportation Theme over time to meet the growing needs of the geospatial community.

The USDOT will continue efforts to move toward using cloud services for geospatial data management. The GMO, which administers shared Departmental geospatial hardware and software advocates for increased modal participation in the Department's shared services to reduce OA costs over maintaining their own GIS servers. Additionally, users have repeatedly asked for information about non-ESRI geospatial software packages. Increased funding contributions from the OAs would allow the GMO to host a "test lab" for this software and determine whether they are suitable to add to DOT's Common Operating Environment and shared service. This software could assist DOT in making data more open and accessible.[38]

[38] USDOT GIS Strategic Plan

9 Conclusion

The Transportation Theme brings together foundational transportation geospatial datasets that multiple Federal agencies compile and manage. The rapid worldwide rise in geospatial analysis and applications has increased the value of accurate, accessible Transportation Theme data. The strategy presented here empowers users, engages stakeholders, and provides maximum benefit to the public. With input from the Transportation Theme community, it will also help USDOT and its partners accomplish the activities necessary to achieve their shared vision for the theme now and in the future:

The Transportation Theme of the National Spatial Data Infrastructure enables people to access, visualize, analyze, and understand critical transportation data while driving innovation and promoting transportation safety, efficiency, economic development, and national and global connectivity.

10 Appendices

10.1 Mapping Goal 1 to the NSDI Strategic Plan and the GDA

Goal ID	NSDI Goal		NSDI Subject
1	Implement Federal Geospatial Policies and Governance Framework		Policy and Governance
Obj. ID	**Transportation Theme Objective**	**GDA Item**	**GDA Subject**
1.1	Coordinate the management of data, supporting resources, and related services and products of the Transportation Theme	2805.b.2	LCA Responsibilities
1.1	Lead and facilitate the development and implementation of a plan for nationwide population of the Transportation Theme	2805.b.3.B	Theme Development
1.1	Administer the Transportation Theme according to the GDA	2805.b.3.E	Theme Administration
Action ID	**Transportation Theme Action**	**GDA Item**	**GDA Subject**
1.1.1	Establish goals that support the strategic plan for the NSDI prepared under 43 USC Ch. 46, §2804(c) of the GDA.	2805.b.3.C	Theme Development
1.1.2	Expedite the maturation of the Transportation Theme by through the effective implementation of theme strategies.	§2805.b.3.B.v	Theme Development
1.1.3	Address the human and financial resource needs of the Transportation Theme. Appendix 10.8 details how the theme addresses human and financial resource needs.	2805.b.3.B.iii	Theme Development
1.1.4	Identify needs relating to standards, metadata for geospatial data, and the GeoPlatform	2805.b.3.B.iv	Theme Development
1.1.5	Lead and facilitate the development of the DOT GIS Strategic Plan by defining the actions CAs will take to meet the responsibilities defined in section 2808 of the GDA successfully	2808.a.1	NGDA Administration
1.1.6	Submit a performance report annually to the FGDC, at least annually, that documents the activities relating to and implementation of the National Geospatial Data Asset data theme, including progress in achieving the requirements	2805.b.3.E.ii.I	Theme Administration
1.1.7	Respond to comments from the FGDC, as appropriate, regarding the summary and evaluation of the performance report	2805.b.3.E.ii.II	Theme Administration

10.2 Mapping Goal 2 to the NSDI Strategic Plan and the GDA

Goal ID	NSDI Goal		NSDI Subject
2	Mature the Transportation Theme Through Expanded Data Sources and Accelerated Data Acquisition		NGDAs
Obj. ID	**Transportation Theme Objective**	**GDA Item**	**GDA Subject**
2.1	Lead and facilitate the development and implementation of geospatial data standards for the Transportation Theme, with an emphasis on data content standards	2805.b.3.A	Geospatial Data Standards
Action ID	**Transportation Theme Action**	**GDA Item**	**GDA Subject**
2.1.1	Recognizing the development continuum of NGDAs, the USDOT will establish a GSIP consistent with the NSDI.	2805.b.3.A.iii.II	Geospatial Data Standards
2.1.2	The GSIP shall assess existing standards	2805.b.3.A.i	Geospatial Data Standards
2.1.2	The GSIP shall identify anticipated or needed data standards	2805.b.3.A.ii	Geospatial Data Standards
2.1.2	The GSIP shall detail a process to originate and implement needed standards with relevant community and international practices	2805.b.3.A.iii	Geospatial Data Standards
2.1.2	The GSIP shall develop needed standards is accordance with OMB Circular A–119, or any successor	2805.b.3.A.iii.I	Geospatial Data Standards
2.1.3	Develop procedures to assess annually data gaps, source gaps, data collection processes, data integration processes, and best practice.		

10.3 Mapping Goal 3 to the NSDI Strategic Plan and the GDA

Goal ID	NSDI Goal		NSDI Subject
3	Promote open standards-based interoperability to enable geospatial shared services		Geospatial Shared Services
Obj. ID	**Transportation Theme Objective**	**GDA Item**	**GDA Subject**
3.1	Foster the use of the GeoPlatform	2805.b.3.E.iv	Theme Administration
3.1	Coordinate with the GeoPlatform	2805.b.3.E.v	Theme Administration
Action ID	**Transportation Theme Action**	**GDA Item**	**GDA Subject**
3.1.1	Designate a point of contact within the lead covered agency who shall be responsible for developing, maintaining, coordination relating to, and disseminating data using the GeoPlatform	2805.b.3.E.i	Theme Administration
3.1.2	Encourage individuals and entities that are a source of geospatial data or metadata for geospatial data for the Transportation Theme to provide access to such data through the GeoPlatform	2805.b.3.E.iv	Theme Administration

10.4 Mapping Goal 4 to the NSDI Strategic Plan and the GDA

Goal ID	NSDI Goal		NSDI Subject
4	Enable and promote collaborative partnerships to meet national needs and priorities for geospatial, and circumstances		Collaborative Governance and Partnerships
Obj. ID	**Transportation Theme Objective**	**GDA Item**	**GDA Subject**
4.1	Meet the needs of users of Transportation Theme data	2805.b.3.B.ii	Theme Development
Action ID	**Transportation Theme Action**	**GDA Item**	**GDA Subject**
4.1.1	Develop partnership programs with States, Indian tribes, institutions of higher education, private sector entities, other Federal agencies, and local governments	2805.b.3.B.i	Theme Development
4.1.2	Leverage partnership programs to solicit input on the need and use of transportation data and services.	2805.b.3.B.i	Theme Development
4.1.3	As necessary, collect and analyze information from users of geospatial data within the Transportation Theme regarding the needs of the users for geospatial data and incorporate the needs of users in strategies relating to the Transportation Theme	2805.b.3.D	User Needs
4.1.4	Identify and publish proven practices for the use and application of geospatial data of the LCA	2805.b.3.E.vi	Theme Administration
4.1.5	Publish maps or comparable graphics online (in accordance with the mapping conventions specified by the FGDC showing the extent and status of the NGDA data themes for which the CA is an LCA	2805.b.3.E.iii	Theme Administration

10.5 Section 2808 of the GDA

§2808. Covered agency responsibilities

(a) In general

Each covered agency shall—

(1) prepare, maintain, publish, and implement a strategy for advancing geographic information and related geospatial data and activities appropriate to the mission of the covered agency, in support of the strategic plan for the National Spatial Data Infrastructure prepared under section 2804(c) of this title;

(2) collect, maintain, disseminate, and preserve geospatial data such that the resulting data, information, or products can be readily shared with other Federal agencies and non-Federal users;

(3) promote the integration of geospatial data from all sources;

(4) ensure that data information products and other records created in geospatial data and activities are included on agency record schedules that have been approved by the National Archives and Records Administration;

(5) allocate resources to fulfill the responsibilities of effective geospatial data collection, production, and stewardship with regard to related activities of the covered agency, and as necessary to support the activities of the Committee;

(6) use the geospatial data standards, including the standards for metadata for geospatial data, and other appropriate standards, including documenting geospatial data with the relevant metadata and making metadata available through the GeoPlatform;

(7) coordinate and work in partnership with other Federal agencies, agencies of State, tribal, and local governments, institutions of higher education, and the private sector to efficiently and cost-effectively collect, integrate, maintain, disseminate, and preserve geospatial data, building upon existing non-Federal geospatial data to the extent possible;

(8) use geospatial information to—

(A) make Federal geospatial information and services more useful to the public;

(B) enhance operations;

(C) support decision making; and

(D) enhance reporting to the public and to Congress;

(9) protect personal privacy and maintain confidentiality in accordance with Federal policy and law;

(10) participate in determining, when applicable, whether declassified data can contribute to and become a part of the National Spatial Data Infrastructure;

(11) search all sources, including the GeoPlatform, to determine if existing Federal, State, local, or private geospatial data meets the needs of the covered agency before expending funds for geospatial data collection;

(12) to the maximum extent practicable, ensure that a person receiving Federal funds for geospatial data collection provides high-quality data; and

(13) appoint a contact to coordinate with the lead covered agencies for collection, acquisition, maintenance, and dissemination of the National Geospatial Data Asset data themes used by the covered agency.

10.6 Abbreviations and Acronyms

AASHTO	American Association of State Highway Officials
BTS	Bureau of Transportation Statistics
CA	Covered Agency
CAV	Connected and automated vehicle
CG	Coordination Group
Census	Bureau of Census
FAA	Federal Aviation Administration
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
GDA	Geospatial Data Act
GSDP	Geospatial Standards Development Plan
GTS	Geospatial Transportation Subcommittee
JSON	JavaScript Object Notation
IGIF	Integrated Geospatial Information Framework
LCA	Lead Covered Agency
NGDA	National Geospatial Data Asset
NSDI	National Spatial Data Infrastructure
NSGIC	National States Geographic Information Council
OA	Operating Administration
OMB	Office of Management and Budget
OST	Office of the Secretary of Transportation
REST	Representational State Transfer
SAOGI	Senior Agency Official for Geospatial Information
TIGER	Topologically Integrated Geographic Encoding and Referencing
TIP	Transportation Implementation Plan
TRB	Transportation Research Board
TTSP	Transportation Theme Strategic Plan
UN-GGIM	United Nations Global Geospatial Information Management
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
WZDWG	Work Zone Data Working Group

10.7 Acknowledgments

The Transportation Theme Strategic Plan relied heavily on the NSDI Strategic Plan. An interagency team from the FGDC developed the NSDI Strategic Plan with significant inputs from the National Geospatial Advisory Committee. The following organizations participated in "NSDI Leaders Forum" listening sessions in 2020 and provided inputs and (or) comments that helped inform the development of the plan:

American Society of Photogrammetry and Remote Sensing
American Association of Geographers
AmericaView
Cartography and Geographic Information Society
Coalition of Geospatial Organizations
GIS Certification Institute
International Association of Assessing Officers
International Cartographic Association
National Society of Professional Surveyors
National States Geographic Information Council
Open Geospatial Consortium
University Consortium for Geographic Information Science
Urban and Regional Information Systems Association
U.S. Geospatial Intelligence Foundation

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Bureau of Transportation Statistics
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Federal Aviation Administration
Federal Geographic Data Committee
Federal Highway Administration
Federal Rail Administration
Federal Transit Administration
U.S. Army Corps of Engineers
USDOT - Geospatial Management Office
Volpe Center National Transportation Systems Center

10.8 Addressing the Theme's Human and Financial Resources Needs

The processes below defines how the transportation theme's human and financial resource needs are addressed as required by section 2805.b.3.B.iii of the GDA.

10.8.1 Geospatial Information Business Models

Three common Geographic Information (GI) business models are used to create and deliver value to citizens. Geographic Data Providers (Providers) offer data or services, produced by themselves or by other data producers, to other users[39]. Geographic Data Enablers (Enablers) assist other organizations in managing, publishing, and using geographic data. Enabling organizations usually fulfill an intermediary role between providers and Geographic Data End Users (Users) of geographic data[40]. Users are different from providers or enablers because geographic data are not central to their core processes or activities. Users employ geographic data to support their primary mission[41].

The Transportation Theme is an enabler. The theme assists its partners in managing, publishing, and curating National Geospatial Data Assets (NGDA) and their related services. The theme is an intermediary between providers and users.

10.8.2 Identifying the Correct Business Model

Accurately describing the theme's business model helps us understand where the boundary between theme administration and data production lies. Understanding the boundary between theme administration and data production fosters better administration through an informed, and more effective, allocation of resources. Better administration maximizes the theme's public value.

10.8.3 Defining the Boundary Between Theme Administration and Data Production

Theme administration and data production are separate endeavors. They occur under separate mandates, are overseen by separate authorities, and are funded from separate budgets. The U.S. Army Corps of Engineers (USACE) exemplifies the separation between theme administration and data production. The waterway layers produced by the USACE, and agency within the Department of Defense (DOD), are included transportation theme.

The GDA exempts all DOD agencies from its mandates. So, despite being exempt from the GDA, operating under a different mandate, being overseen by a different authority, and being funded from a separate budget, the USACE produces one-third of the theme's fifteen NGDAs. To further demonstrate the separation of theme administration and data production consider this: If all civilian federal geospatial data management policies were eliminated, the USACE's status quo would be maintained; It would continue to operate unchanged.

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[39] Vancauwenberghe, G., Donker, F. W., & Van Loenen, B. (2019). Business Models for Geographic Information. In J. B. Kruse, J. Crompvoets, & F. Pearlman, *GEOValue: The Socioeconomic Value of Geospatial Information* (pp. 85-115). Boca Raton, London, New York: CRC Press.

[40] Ibid. pp. 85-115

[41] Ibid. pp. 85-115

10.8.4 Framework for addressing the Themes Human and Financial Resource Needs

Recognizing the separation between administration and data production frames how the transportation theme addresses its human and financial resource needs. The theme uses quantitative methods to measure its administration needs because it has access to the needed financial information. The theme uses qualitative methods to measure its partner's production needs because the theme lacks access to the needed financial information.

10.8.5 Theme Staffing Estimate

BTS and the GMO in the Office of the Chief Information Officer (OCIO) share theme management responsibilities. The GMO supplies policy oversight and enforcement. BTS supplies theme management services through the Office of Spatial Analysis and Visualization (OSAV).

Human resource costs are estimated by 1) identifying the staff that contribute to theme management, 2) quantifying the staff's effort, and 3) monetizing their effort. Monetization simply multiplies the staff members' rate by their estimated effort. Below is an example of how the Theme Staffing Estimate is Calculates.

Identify the staff that contribute to the administration of the transportation theme.

Transportation Theme Staff

Agency	Staff	Theme Role
GMO	Chief GIO	Policymaker
GMO	Deputy Chief GIO	Policymaker
OSAV	Director – OSAV	Policymaker
OSAV	Theme Lead	Broker
OSAV	Theme Support	Broker
OSAV	NTAD Program Manager	Provider
OSAV	Database Administrator	Provider
OSAV	Data Quality Analyst	Provider
OSAV	Metadata Curator	Provider

Estimate and monetize the efforts of the GMO and BTS staff.

GMO Staffing Estimate

Agency	Staff	Effort	Full-Cost	Theme-Cost
GMO	Chief GIO	.05	$170,800.00	$8,540.00
GMO	Deputy GIO	.05	$149,621.00	$7,481.05
			Total	**$16,021.05**

BTS Staffing Estimate

Agency	Staff	Effort	Full-Cost	Theme-Cost
OSAV	Director – OSAV	.05	$170,800.00	$8,540.00
OSAV	Theme Lead	1	$133,447.00	$133,447.00
OSAV	Theme Support	1	$160,841.88	$160,841.88
OSAV	NTAD Program Manager	.4	$112,930.00	$45,172.00
OSAV	Database Administrator	.425	$237,523.00	$100,947.28
OSAV	Data Quality Analyst	.13	$163,199.84	$21,215.98
OSAV	Metadata Curator	.13	$146,349.6	$19,025.45
			Total	**$489,189.59**

Add the GMO staff estimate ($16,021.05) to the BTS staff estimate ($489,189.59) to get the Theme Staffing Estimate ($505,210.64).

GMO Staffing Estimate + BTS Staffing Estimate = Theme Staffing Estimate Formula 1

$16,021.05 + $489,189.59 = **$505,210.64**

10.8.6 Shared Services Estimates

The Geospatial Management Office offers a shared services environment (SSE). The SSE is an Information Technology platform used to publish geospatial data and services. Departmental agencies pool their funds to pay for the platform. Additionally, there are information technology and personnel costs associated with the SSE.

Estimating the theme's portion of operating the SSE requires working with the GMO to determine 1) the percentage BTS (B) pays into the pooled fund, 2) the IT cost (I) of operating the SSE and 3) the personnel cost (P) associated with operating the SSE. The Shared Services Estimate is calculated by adding the IT and personnel cost and them multiplying that by the percentage BTS pays into the pooled fund. An example follows.

(I+P)B = SSE Estimate Formula 2

($82,585.93 + $121,316.00) 0.0428 = $8,727.00

SSE Estimate = $8,727.00

BTS pays for 4.28% (B) of the pooled platform. The SSE has information technology (I) and personnel (P) costs. The information technology costs are $82,585.93. Personnel costs are $121,316.00. Total SSE costs are $203,901.93. Multiplying the total SSE costs by 4.28% equal $8,727.00.

10.8.7 Theme Administration Estimate

Adding the Theme Staffing Estimate to the SSE Estimate results in the Theme Administration Estimate.

Theme Staffing Estimate + SSE Estimate = Theme Administration Estimate Formula 3

$505,210.63 + $8,727.00 = $513,937.63

10.8.8 Addressing Partner Resource Needs

Partner programs supply source data to the Transportation Theme or publish NGDAs directly to the internet. Theme partners include BTS, the Federal Aviation Administration (FAA), the Federal Highway Administration (FHWA), the Bureau of the Census (Census), and the U.S. Army Corp of Engineers (USACE).

We examine performance characteristics about each partner to address their human and financial resource needs. These performance characteristics include policy mandates, dedicated funding, past performance, and resource availability. Each characteristic helps the theme understand the context in which its partners work and the challenges they face. A better understanding of our partner's context and challenges fosters effective theme administration.

Laws or executive orders mandating partners to collect data are excellent indicators of administrative and financial resources. Programs with dedicated funding and reliable administrations are likely to have the human and financial resources they need to fulfill the NSDI mission. Past performance examines each partner's legacy; Chronicled success indicates a likelihood of continued success. Finally, the theme asks partner agencies to provide a qualitative assessment about the availability of their human and financial resources. The table below provides an example the qualitative analysis. It summarizes the characteristics of each NGDA in the transportation theme.

Qualitative Characteristics of Partner Programs

NGDA	Mandate	Funding	Past Performance	Resource Impressions
Airports	USC49-44721	USDOT	The theme has successfully partnered with the FAA to foster airports and runways access, as part of the National Transportation Atlas Database (NTAD), since 1995.	Brain Murphy, Manager of the Aeronautical Information Group, expressed confidence in the FAA's human and financial resources in an email on 3/10/2022.
Runways	USC49-44721			
Bridges	USC 23-44	USDOT	The theme has partnered with the FHWA to foster NBI access, as part of the NTAD, since 2008.	Everett Matias, a FHWA Team Leader, expressed confidence in the FHWA's human and financial resources in an email on 3/21/2022.
Freight Facilities	USC 49-63	Highway Trust Fund	The theme has successfully partnered with BTS to foster freight facilities access, as part of the NTAD, since 2004.	Ed Strocko, the OSAV Office Director, expressed confidence in BTS' human and financial resources in an email on 3/9/2022.
Passenger Facilities	USC 49-63		The theme has successfully partnered with BTS to foster	

			passenger facilities access, as part of the NTAD, since 2013.	
Transit Lines & Stations	USC 49-63		The theme has successfully partnered with BTS to foster access to a national transit layer, as part of the NTAD, since 1995.	
Rail Lines and Node	Safety Freight Policy Rail Policy STB Waybill	Safety & Operations Budget	The theme has successfully partnered with the FRA to enable access to a national railroad networks, as part of the NTAD, since 1995.	Raquel Wright, the NARN Program Director, expressed confidence in the FAA's human and financial resources in an email on 3/9/2022.
Roads	None	Dept. of Commerce	Census has supplied digital updates to TIGER/LINE files since 2006.	Dierdre Bevington-Attard, Branch Chief of Federal Geographic Coordination, expressed confidence in the Census' human and financial resources in an email on 3/2/2022.

10.8.9 Conclusions

The theme uses the quantitative and qualitative data to assess the likelihood of continued success. Characteristics indicating potential trouble are addressed by geospatial data management leadership.